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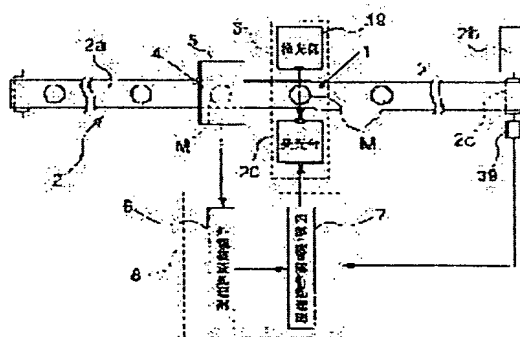
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(54) EVALUATION APPARATUS

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an evaluation apparatus, capable of analyzing the interior quality of an object to be measured and reducing the cost, while permitting examination of the appearance of the object, and facilitating installation work and maintenance work.

SOLUTION: The evaluation apparatus comprises a conveying means 2 for conveying the object M to be measured for passing a position 1 to be measured about the interior quality; an appearance detecting means 5 for detecting the appearance information of the object M, disposed at the position 4 to be inspected of an upstream side from the position 1 to be measured about the interior quality in the conveying direction of the object M of the means 2; and a control means 8 for examining the appearance of the object M, based on the detection information of the means 5 and managing the positional information of the object M to the position 1, based on the position information of the object M in the conveying means, when the appearance of the object M is examined to control a light-emitting and photodetecting means 3.



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CLAIMS

[Claim(s)]

[Claim 1] A conveyance means to convey a measured object is established so that it may pass through the part for internal quality measurement, and light is irradiated at said measured object located in said part for internal quality measurement. It is evaluation equipment equipped with the control means which analyzes the internal quality of said measured object by the light which controlled actuation of a light emitting/receiving means to receive the transmitted light or the reflected light from said measured object, and its light emitting/receiving means, and received light with said light emitting/receiving means. An appearance detection means to detect the appearance information on said measured object that it is located in the part for visual-inspection measurement of the upstream rather than said part for internal quality measurement in the conveyance direction of said measured object in said conveyance means is established. While inspecting the appearance of said measured object based on the detection information on said appearance detection means, said control means Evaluation equipment constituted so that the positional information of said measured object to said part for internal quality measurement may be managed and said light emitting/receiving means may be controlled based on the positional information of said measured object in said conveyance direction when inspecting the appearance of the measured object.

[Claim 2] A conveyance means to convey a measured object is established so that it may pass through the part for internal quality measurement, and light is irradiated at said measured object located in said part for internal quality measurement. It is evaluation equipment equipped with the control means which analyzes the internal quality of said measured object by the light which controlled actuation of a light emitting/receiving means to receive the transmitted light or the reflected light from said measured object, and its light emitting/receiving means, and received light with said light emitting/receiving means. An appearance detection means to detect the appearance information on said measured object that it is located in the part for visual-inspection measurement of the upstream rather than said part for internal quality measurement in the conveyance direction of said measured object in said conveyance means is established. Evaluation equipment constituted so that measurement conditions in case said control means analyzes the internal quality of said measured object based on the detection information on said appearance detection means, while inspecting the appearance of said measured object based on the detection information on said appearance detection means may be adjusted.

[Claim 3] Evaluation equipment according to claim 2 constituted so that said control means may adjust the amount of light emitting/receiving by said light emitting/receiving means when analyzing the internal quality of said measured object based on the detection information on said appearance detection means.

[Claim 4] Evaluation equipment according to claim 2 or 3 constituted so that said control means may adjust the relative-position relation of said part for internal quality measurement and said light emitting/receiving means based on the magnitude information on said measured object in the detection information on said appearance detection means.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] A conveyance means to convey a measured object is established so that it may pass through the part for internal quality measurement, and this invention irradiates light at said measured object located in said part for internal quality measurement. It is related with evaluation equipment equipped with the control means which analyzes the internal quality of said measured object by the light which controlled actuation of a light emitting/receiving means to receive the transmitted light or the reflected light from said measured object, and its light emitting/receiving means, and received light with said light emitting/receiving means.

[0002]

[Description of the Prior Art] The internal quality evaluation equipment to which the above evaluation equipments analyze the internal quality of a measured object by the light which the light emitting/receiving means was operated so that light might be irradiated at the measured object and the transmitted light or the reflected light from the measured object might be received, when measured objects, such as garden stuff, passed through the part for internal quality measurement, and received light with the light emitting/receiving means is formed. And after [for example,] carrying out the spectrum of the transmitted light or the reflected light from a measured object in a concave grating, The line sensor of the charge accumulation-of-electricity type which arranged in in the shape of an array the photo detector which consists of two or more optoelectric transducers etc. is used as a light emitting/receiving means. the spectrum measured with such a light emitting/receiving means -- the spectrum measured with a light emitting/receiving means since the internal quality of measured objects, such as garden stuff, is reflected in spectrum data -- based on spectrum data, the internal quality of measured objects, such as garden stuff, is analyzed.

[0003] From it being required to operate a light emitting/receiving means to the timing to which the measured object conveyed with a conveyance means is located in the part for internal quality measurement with said internal quality evaluation equipment In the conveyance direction of the measured object in a conveyance means rather than the part for internal quality measurement to the upstream For example, a positional information detection means to detect the positional information of the measured object in the conveyance directions, such as a position sensor which detects that the measured object passed, is established. He manages the positional information of the measured object to the part for internal quality measurement, and is trying to operate a light emitting/receiving means to exact timing based on the detection information on the positional information detection means. Moreover, if internal quality evaluation equipment changes a configuration, magnitude, etc. of a measured object Since there is a possibility that the quantity of light of the transmitted light from a measured object or the reflected light can change, light of a setting proper amount cannot be received with a light emitting/receiving means, and internal quality of a measured object cannot be measured with a sufficient precision From to adjust the measurement conditions when analyzing the internal quality of a measured object according to a configuration, magnitude, etc. of a measured object being desired He

establishes the detection means for acquiring information, such as a configuration of a measured object, and magnitude, and is trying to adjust the measurement conditions when analyzing the internal quality of a measured object based on the detection information on the detection means.

[0004] While conveying a measured object with this kind of evaluation equipment so that it may pass through the part for visual-inspection measurement with a conveyance means An appearance detection means to detect the appearance information on a measured object that it is located in the part for visual-inspection measurement is established. In addition to above-mentioned internal quality equipment, based on the detection information on an appearance detection means, the visual-inspection equipment which inspects the appearance of a measured object is formed, and, in addition to the analysis of the internal quality of a measured object, there is a thing he is trying to inspect the appearance of a measured object. An image pick-up means to picturize for example, a measured object is used for this visual-inspection equipment as an appearance detection means. While an image pick-up means is operated so that the measured object located in the part for visual-inspection measurement may be picturized, and acquiring the positional information of the measured object in the conveyance direction based on the image information of the image pick-up means Appearance information, such as a configuration of a measured object and magnitude, is acquired, and it is constituted so that the appearance configuration of a measured object may inspect normal, abnormalities, etc.

[0005] Although he is trying to inspect the appearance of a measured object while forming the internal quality evaluation equipment which analyzes the internal quality of a measured object, and the visual-inspection equipment which inspects the appearance of a measured object with this kind of evaluation equipment and analyzing the internal quality of a measured object like **** For example, various kinds of information, such as a configuration, magnitude, etc. of the positional information of the measured object in the conveyance direction or a measured object, is managed by each ** by each of internal quality evaluation equipment and visual-inspection equipment, and he is trying to control these two equipments to each **.

[0006]

[Problem(s) to be Solved by the Invention] However, with above evaluation equipment, various kinds of information, such as a configuration, magnitude, etc. of the positional information of the measured object in the conveyance direction or a measured object, is managed by each ** by each of internal quality evaluation equipment and visual-inspection equipment. Since these two equipments are controlled by each **, it is necessary to form the detection means for detecting various kinds of information etc. in each equipment. To eye others While components mark, such as a detection means, increase and causing a cost rise, there is a possibility that installation and a maintenance may become troublesome.

[0007] This invention is in the point of offering the evaluation equipment which becomes possible [aiming at reduction of cost and attaining easy-ization of installation and a maintenance], making it possible to inspect the appearance of a measured object while it is made paying attention to this point and analyzes the internal quality of a measured object.

[0008]

[Means for Solving the Problem] In order to attain this purpose, according to invention according to claim 1, a conveyance means to convey a measured object is established so that it may pass through the part for internal quality measurement, and light is irradiated at said measured object located in said part for internal quality measurement. In evaluation equipment equipped with the control means which analyzes the internal quality of said measured object by the light which controlled actuation of a light emitting/receiving means to receive the transmitted light or the reflected light from said measured object, and its light emitting/receiving means, and received light with said light emitting/receiving means An appearance detection means to detect the appearance information on said measured object that it is located in the part for visual-inspection measurement of the upstream rather than said part for internal quality measurement in the conveyance direction of said measured object in said conveyance means is established. While inspecting the appearance of said measured object based on the detection information on said appearance detection means, said control means Based on the positional information

of said measured object in said conveyance direction when inspecting the appearance of the measured object, the positional information of said measured object to said part for internal quality measurement is managed, and it is constituted so that said light emitting/receiving means may be controlled.

[0009] Namely, since an appearance detection means detects the appearance information on a measured object that it is located in the part for visual-inspection measurement of the upstream rather than the part for internal quality measurement in the conveyance direction of a measured object While inspecting the appearance of a measured object based on the detection information on an appearance detection means, a control means becomes possible [acquiring the positional information of the measured object in the conveyance direction] based on the detection information on an appearance detection means, when it inspects the appearance of a measured object. And since the control means is constituted based on the positional information of the measured object in the conveyance direction acquired when inspecting the appearance of a measured object so that the positional information of the measured object to the part for internal quality measurement may be managed, it becomes possible to operate a light-emitting/receiving means of the measured object conveyed with a conveyance means to the timing located in the part for internal quality measurement. Thus, a control means becomes possible [analyzing the internal quality of said measured object by the light which received light with the light emitting/receiving means] by operating a light emitting/receiving means to the timing located in the part for internal measurement.

[0010] Therefore, even if it does not establish a positional information detection means to detect the positional information of the measured object in the conveyance direction etc. The measured object with which a control means is conveyed with a conveyance means using the positional information of the measured object in the conveyance direction acquired when inspecting the appearance of a measured object operates a light emitting/receiving means to the timing located in the part for internal quality measurement, and becomes possible [analyzing the internal quality of a measured object].

[0011] It was able to come to offer the evaluation equipment which becomes possible [aiming at reduction of cost and attaining easy-ization of installation and a maintenance from the above thing, making it possible to inspect the appearance of a measured object, while analyzing the internal quality of a measured object according to invention according to claim 1,].

[0012] According to invention according to claim 2, a conveyance means to convey a measured object is established so that it may pass through the part for internal quality measurement, and light is irradiated at said measured object located in said part for internal quality measurement. In evaluation equipment equipped with the control means which analyzes the internal quality of said measured object by the light which controlled actuation of a light emitting/receiving means to receive the transmitted light or the reflected light from said measured object, and its light emitting/receiving means, and received light with said light emitting/receiving means An appearance detection means to detect the appearance information on said measured object that it is located in the part for visual-inspection measurement of the upstream rather than said part for internal quality measurement in the conveyance direction of said measured object in said conveyance means is established. While said control means inspects the appearance of said measured object based on the detection information on said appearance detection means, it is constituted so that the measurement conditions when analyzing the internal quality of said measured object may be adjusted based on the detection information on said appearance detection means.

[0013] That is, since an appearance detection means detects the appearance information on a measured object are located in the part for visual-inspection measurement of the upstream rather than the part for internal quality measurement in the conveyance direction of a measured object, a control means becomes possible [acquiring appearance information, such as the configuration of a measured object, and magnitude, from the detection information on an appearance detection means], while inspecting the appearance of a measured object based on the detection information on an appearance detection means. And since the control means is constituted so that the measurement conditions when analyzing the internal quality of a measured object may be adjusted based on the appearance information on the measured object obtained when inspecting the appearance of a measured object A control means becomes possible [adjusting the measurement conditions when analyzing the internal quality of a measured object to the measurement conditions which become possible / measuring the internal quality

of a measured object with a sufficient precision / according to the appearance information on a measured object].

[0014] Therefore, even if it does not establish the detection means for acquiring information, such as a configuration of a measured object, and magnitude A control means adjusts the measurement conditions when analyzing the internal quality of a measured object according to the appearance information on a measured object using the appearance information on the measured object obtained from the detection information on an appearance detection means, and becomes possible [measuring the internal quality of a measured object with a sufficient precision].

[0015] It was able to come to offer the evaluation equipment which becomes possible [aiming at reduction of cost and attaining easy-ization of installation and a maintenance from the above thing, making it possible to inspect the appearance of a measured object, while analyzing the internal quality of a measured object according to invention according to claim 2,].

[0016] According to invention according to claim 3, said control means is constituted so that the amount of light emitting/receiving by said light emitting/receiving means when analyzing the internal quality of said measured object may be adjusted based on the detection information on said appearance detection means.

[0017] That is, when the amount of light emitting/receiving by the light emitting/receiving means when analyzing the internal quality of a measured object is being fixed to a constant rate for example, and the appearance of a measured object changes, the light income by the light emitting/receiving means changes, and light of a setting proper amount cannot be received with a light emitting/receiving means, but there is a possibility that the internal quality of a measured object may be immeasurable with a sufficient precision. Since the control means is constituted to it based on appearance information acquired from the detection information on an appearance detection means, such as a configuration of a measured object, and magnitude, so that the amount of light emitting/receiving by the light emitting/receiving means when analyzing the internal quality of a measured object may be adjusted According to the appearance information on a measured object, it becomes possible to adjust the amount of light emitting/receiving of a light emitting/receiving means so that the light of a setting proper amount may be received with a light emitting/receiving means. Therefore, even if the appearance of a measured object changes, it becomes possible in the condition corresponding to the change to analyze the internal quality of a measured object, and it becomes possible to measure the internal quality of a measured object with a much more sufficient precision.

[0018] According to invention according to claim 4, based on the magnitude information on said measured object in the detection information on said appearance detection means, said control means is constituted so that the relative-position relation of said part for internal quality measurement and said light emitting/receiving means may be adjusted.

[0019] Namely, when [of for example the part for internal quality measurement, and a light emitting/receiving means] the magnitude of a measured object fixes relative-position relation to proper relative-position relation to a large thing When the magnitude of a measured object becomes small, the light which turns around a measured object among the light which irradiated the measured object will arise, the light around which it turned will be received with a light emitting/receiving means, an S/N (signal pair noise) ratio becomes small, and there is a possibility that the internal quality of a measured object may be immeasurable with a sufficient precision. Since the control means is constituted to it based on the magnitude information on the measured object in the detection information on an appearance detection means so that the relative-position relation between the part for internal quality measurement and a light emitting/receiving means may be adjusted It becomes possible to adjust the relative-position relation between the part for internal quality measurement, and a light emitting/receiving means so that the light to which the light emitting/receiving means turned around the measured object may not be received according to the magnitude of a measured object. Therefore, even if the magnitude of a measured object changes, it becomes possible in the condition corresponding to the change to analyze the internal quality of a measured object, and it becomes possible to measure the internal quality of a measured object with a much more sufficient precision.

[0020]

[Embodiment of the Invention] About the evaluation equipment concerning this invention, it prepares for the fruit-sorting facility which performs sorting classification of a mandarin orange as a measured object, magnitude, the appearance, i.e., the appearance configuration, of a mandarin orange, etc. is inspected, and the case where it applies to the configuration which measures the internal quality information of a mandarin orange, i.e., a sugar content, acidity, etc., is explained based on a drawing.

[0021] The [1st operation gestalt] The conveyance conveyor 2 as a conveyance means to convey the measured object M (mandarin orange) so that this evaluation equipment may pass through the part 1 for internal quality measurement, as shown in drawing 1, The light projecting/receiving part 3 as a light emitting/receiving means to irradiate light at the measured object M located in the part 1 for internal quality measurement, and to receive the transmitted light from the measured object M, In the conveyance direction of the measured object M in the conveyance conveyor 2, the appearance detecting element 5 as an appearance detection means to detect the appearance information on the measured object M that it is located in the part 4 for visual-inspection measurement of the upstream etc. is formed, and it consists of parts 1 for internal quality measurement.

[0022] And the control section 8 as a control means equipped with the internal quality analysis processing section 7 which analyzes the internal quality of the measured object M by the light which this evaluation equipment controlled actuation of the visual-inspection processing section 6 which inspects appearances, such as an appearance configuration of the measured object M and magnitude, and a light projecting/receiving part 3 based on the detection information on the appearance detecting element 5, and received light with the light projecting/receiving part 3 is formed. Moreover, based on the positional information of the measured object M in the conveyance direction acquired when the visual-inspection processing section 6 inspects the appearance of the measured object M, the internal quality analysis processing section 7 manages the positional information of the measured object M to the part 1 for internal quality measurement, and it is constituted so that the light emitting/receiving means 3 may be controlled.

[0023] Moreover, the measured object M is constituted so that it may have become column-like by the single tier at the setting rate with the configuration by which installation conveyance is carried out and may pass through the part 4 for visual-inspection measurement, and the part 1 for internal quality measurement one by one by conveyance conveyor 2. Said conveyance conveyor 2 has the composition of driving endless rotation band 2a with electric motor 2b, it has the rotary encoder 39 which detects the rotation condition of the revolving shaft of body-of-revolution 2c which winds that endless rotation band 2a, and the detection information on this rotary encoder 39 has the composition of being inputted into a control section 8.

[0024] First, the visual inspection of the measured object M in the part 4 for visual-inspection measurement is explained. As shown in drawing 3, drawing 4, and drawing 5, the lighting section 10 illuminated to the measured object M used as the candidate for an image pick-up by the color-type color CCD camera 9 and color CCD camera 9 of 3 plate type is formed, and said visual-inspection section 5 is constituted so that said visual-inspection processing section 6 may distinguish the fault part of the measured object M based on the image information of color CCD camera 9. In addition, the setting means 11 for carrying out an artificial setup of the criteria information for visual inspection etc. to the visual-inspection processing section 6 is established.

[0025] Said lighting section 10 is constituted so that the reflected light of a light strong against the specific direction may not be generated to the measured object M and it may become indirect lighting on the occasion of photography by color CCD camera 9. That is, color CCD camera 9 is attached in the interior of the housing form reflective cover object 13 located in the upper part side of the conveyance conveyor 2 while applying a reflective paint to a wall and forming the reflective barrier side 12 through support 14, and the light source 16 for lighting which equipped with the curve mold reflecting plate 15 the perimeter section (four places) which separated predetermined spacing to color CCD camera 9 is supported through the support arm 17.

[0026] And since the measured object M which what was reflected in respect of [12] the reflective

barrier once formed in the upper part peripheral wall, and the light which reflected with the curve mold reflecting plate 15, and was further reflected by the upper part peripheral wall are compounded, and this reflected light by which reflective diffusion was carried out covers, and is located under the body 13 irradiates without the illumination light from the light source 16 reaching the measured object M of a direct lower part, it is constituted so that it may become uniform and soft indirect lighting.

Consequently, there is no disadvantage, such as acquiring image pick-up information as information which originated in the strong reflected light of the specific direction, and was mistaken, and the exact measured object M can be picturized. Moreover, photography of the measured object M by color CCD camera 9 is constituted so that it not only radiographs from an upper part side, but the image pick-up information on the right-and-left both-sides section of the measured object M may be acquired through the reflecting mirror 18 arranged in the conveyance direction both-sides section.

[0027] In addition, the bearer rate of the conveyance conveyor 2, the relative position of color CCD camera 9 to an image pick-up field, etc. are set up so that the measured object M of plurality (for example, five pieces) may be picturized by coincidence and, as for the photography visual field (image pick-up field) of the measured object M by color CCD camera 9, one measured object M may pass through the range of this image pick-up field by the setup time (for example, for about 1 second).

Incidentally, about the bearer rate of the conveyance conveyor 2, since it is detectable with a rotary encoder 39, it is also possible to adjust the image pick-up timing by color CCD camera 9 based on the detection information on the rotary encoder 39. Moreover, in order to obtain the static image to the measured object M which is moving continuously, while it has a high-speed electronic shutter and the measured object M passes through the inside of said image pick-up field, color CCD camera 9 is constituted so that two or more division images which divided the perimeter of the measured object M into plurality can be obtained and image incorporation processing can be performed.

[0028] As shown in drawing 2, said visual-inspection processing section 6 is constituted using a microcomputer, and it is constituted so that an image processing may be performed to the picture signal (R, G, B) in three primary colors outputted from color CCD camera 9. And the visual-inspection processing section 6 is based on the image pick-up image of color CCD camera 9. The saturation information showing the saturation of the measured object M, the lightness information showing the lightness of the measured object M, It asks for each showing the chromaticity of the measured object M of chromaticity information. And such saturation information, It is constituted so that fault partial distinction processing which distinguishes the appearance information on the measured object M, for example, the upper limit, distortion of an appearance, etc., may be performed based on the appearance distinction processing and the image pick-up image of color CCD camera 9 which distinguish the fault part of the measured object M based on lightness information and chromaticity information.

[0029] If explanation is added about the control action of said visual-inspection processing section 6, the picture signal (R, G, B) in three primary colors outputted from color CCD camera 9 will be inputted, and HSI transform processing which changes a picture signal into the information showing each information on a chromaticity (H), saturation (S), and lightness (I) will be performed based on the picture signal (R, G, B) in three primary colors. To the picture signal (R, G, B) in three primary colors outputted from color CCD camera 9, data processing will be performed based on the operation expression by following [several 1]- [several 3], and, specifically, the output corresponding to each of a chromaticity (H), saturation (S), and lightness (I) will be obtained.

[0030]

[Equation 1] $I=0.3R+0.59G+0.11B$ [0031]

[Equation 2] $H=\tan^{-1}(C1/C2)$

(However, $C1=R-I$, $C2=B-I$)

[0032]

[Equation 3] $S=\sqrt{C1^2+C2^2}$

(However, $C1=R-I$, $C2=B-I$)

[0033] Next, based on the above-mentioned HSI conversion print-out, by the comparison with the setting threshold beforehand set up to each signal etc., the field of the measured object M in an image is

extracted, and appearance distinction processing of the inspected object M is performed based on the image information of the extracted measured object M. As shown in drawing 6, while said appearance distinction processing extracts the profile L of the appearance of the measured object M About the distance to the point of asking for the center-of-gravity location G of the profile L by the operation, and being located on a profile L from the center-of-gravity location G The change condition in the direction which meets a profile L is searched for with the Fourier transform, and based on the change condition of the distance, the appearance configuration of the measured object M is unusual, or (is there any distortion?) distinguishes whether it is no.

[0034] If it explains concretely, as shown in drawing 7, it can express from distance r and a center-of-gravity location as a function with the include angle theta of the line and the datum line which connect a profile to make as a change condition in the direction which meets the profile L about the distance to the point of being located on a profile L from the center-of-gravity location G. at this time, the front face of a measured object is smooth -- becoming a curve intense [of change of the function of drawing 7], if irregularity exists [the front face of a measured object], although it will become only the low frequency component of spatial frequency if a function also becomes a smooth curve as it is shown in (b) of drawing 7, if circular, and it asks for that Fourier transform, the Fourier transform comes to contain many high-frequency components of spatial frequency f. Therefore, distortion of the appearance configuration of a measured object can be distinguished by distinguishing the condition of such a high-frequency component.

[0035] Moreover, the overall diameter of the measured object M is distinguished based on the information on a profile L. In addition, although the image of two or more measured objects will exist in fact on an image pick-up image, in drawing 6, it is indicated that only one image information is intelligible.

[0036] Next, based on the above-mentioned HSI conversion print-out, fault partial distinction processing which distinguishes the fault part of the measured object M is performed. This fault partial distinction processing sets up the target pixel among two or more pixels which can be first set to the field extracted as a field of the measured object M. The value of the saturation (S) in the pixel distinguishes that it is smaller than the setting saturation threshold S0 set up beforehand, and lightness (I) is [the pixel] a fault part when smaller than the 1st set point I1. That is, it is because the front face of the measured object M has discolored black or a case as dirty black can be considered according to causes -- saturation (S) is low, and lightness (I) pokes with a bird in being quite low.

[0037] moreover, the setting saturation threshold S0 to which the value of saturation (S) was set beforehand -- small -- and lightness (I) -- the 1st -- more than set point I1 -- the 2nd -- in being in the setting range which is less than [set point I2], it distinguishes that the pixel is a fault part. That is, it is because the case where it is in the water corrosion condition etc. can be considered when it originates in disease etc. when saturation (S) is low and lightness (I) is in an in-between setting range, and the front face is in the "slough" condition or.

[0038] In addition, since lightness (I) can remain [drugs etc.] in the front face of for example, the measured object M when larger than the 2nd set point I2, or the fall of the saturation by the variation in lighting etc. can be considered, he is trying not to distinguish from fault in such a case, even if it is the case that the value of saturation (S) is smaller than the setting saturation threshold S0 set up beforehand. When not distinguished from fault, it distinguishes as normal, and it performs about all the pixels of the field from which such distinction actuation was extracted.

[0039] When the part distinguished from fault by processing which was described above is equipped with specific conditions, moreover, specifically A part with low saturation is an approximate circle form, and to the outer diameter of the measured object M, in being close to the magnitude of a predetermined rate, it judges that such a part is a part called HETA and HESO of the measured object M (mandarin orange), and suppose that such a part is excepted from fault.

[0040] Next, the average of the saturation in all the pixels (except for the parts of said HETA and HESO) in the field of a measured object is calculated by the operation, and the average saturation and the standard saturation set up beforehand are measured. With this standard saturation, it is set up as

follows. That is, generally a chromaticity (H) and saturation (S) have the correlation. For example, it is in the inclination for saturation to become high in the case of the chromaticity of a bright color tone.

[0041] Then, the general correlation of such a chromaticity and saturation in the measured object M used as a subject of examination (mandarin orange) is measured beforehand, the saturation which has the above-mentioned correlation corresponding to the actually measured chromaticity is set up as standard saturation by the result picturized by color CCD camera 9, and the average of all the pixels of the measured object M of this standard saturation and the actually measured saturation is compared. And since a case in being low, as average saturation of the front face of the measured object M has withered more than the amount of setup rather than standard saturation, for example can be considered, it distinguishes as fault.

[0042] The analysis of the internal quality of the measured object M in said part 1 for internal quality measurement is explained. the floodlighting section 19 to which said light projecting/receiving part 3 irradiates light at the measured object M (mandarin orange) as shown in drawing 8 , and the light in which the measured object M was penetrated -- a spectrum -- carrying out -- the light which carried out the spectrum -- receiving light -- a spectrum -- it consists of light sensing portions 20 which obtain spectrum data. Moreover, after the light projected from the floodlighting section 19 penetrates the measured object M to the measured object M located in the part 1 for internal quality measurement, in the condition that light is received by the light sensing portion 20, the floodlighting section 19 and a light sensing portion 20 distribute to the right-and-left both-sides part of the part 1 for internal quality measurement, and are arranged.

[0043] The reflecting mirror 24 sideways changed towards the measured object M which said floodlighting section 19 reflects the reflected light by that reflecting plate 23 while having the reflecting plate 23 of the concave surface configuration reflected towards a lower part side so that the light which emits light from the halogen lamp 22 which emits light with the power supplied from a power circuit 21, and this halogen lamp 22 may be made to condense, and is located in the part for measurement is formed. And the shutter device 25 which the light reflected with the reflecting mirror 24 can switch to the condition that the part 1 for internal quality measurement irradiates, and the condition of intercepting light, freely is established.

[0044] In said light sensing portion 20 The condenser lens 26 which condenses the light which penetrated the measured object M, the reflecting mirror 27 which reflects light upward, the color filter 28 which passes only the light of a wavelength field for measurement which is mentioned later, and the shutter device 29 which can be freely switched to the open condition of passing light, and the closed state which intercepts light, if incidence of the light which passed the shutter device 29 of an open condition is carried out -- the light -- a spectrum -- carrying out -- said spectrum -- it has the spectroscopy 30 which measures spectrum data, and is constituted.

[0045] detecting the optical reinforcement for every wavelength in which a spectrum was carried out by the reflecting mirror 32 which reflects the light which carried out incidence from ON **** 31, the concave grating 33 which carries out the spectrum of the reflected light to the light of two or more wavelength, and the concave grating 33, as said spectroscopy 30 is shown in drawing 9 -- a spectrum -- the photo sensor 34 which measures spectrum data has the composition arranged in the black box 35 which consists of a protection-from-light nature ingredient which shades the light from the outside.

[0046] Said photo sensor 34 consists of 1024-bit MOS mold line sensors which change and output the transmitted light by which the part light reflex was carried out by the concave grating 33 to the signal for every wavelength while receiving light for every wavelength to coincidence. Although a detailed explanation is not carried out, this line sensor carries out the interior of the drive circuit for making the capacitor which accumulates the charge obtained in optoelectric transducers, such as a photodiode, and the optoelectric transducer of those for every unit pixel, and its stored charge output outside etc., and is constituted. In addition, an above-mentioned line sensor can make the charge storage time by the capacitor change through a drive circuit from the exterior, and it is constituted so that the light of the wavelength of the range which is 700nm - 1100nm can be detected.

[0047] Said floodlighting section 19 and light sensing portion 20 can be prepared in the condition of

being supported in one with the frame 36 prepared so that the upper part side of the part 1 for internal quality measurement through which the measured object M passes might be bypassed, and this frame 36 can carry out now modification accommodation of the location of the vertical direction of that whole to the conveyance conveyor 2 by the vertical regulatory mechanism 37. Although a detailed explanation is not carried out about said vertical regulatory mechanism 37, it is installed in the state of location immobilization to a fixed part F, and it is constituted so that it may be made to move up and down by screw delivery device 37b driven in electric motor 37a.

[0048] You make it located in the upper part side of the passage part of the measured object M in said conveyance conveyor 2, and the reference filter 38 which is an example of a criteria object is formed in the condition that location immobilization is carried out, by the fixed part F. This reference filter 38 consists of light filters which have a predetermined absorbance property, and, specifically, is constituted using opal glass.

[0049] And as by carrying out centering control of the whole frame 20 in the vertical direction shows to (b) of drawing 10 As it is indicated in (b) of drawing 10 as the usual measurement condition received by the light sensing portion 20 after the light from the floodlighting section 19 penetrates the measured object M laid in the conveyance conveyor 2 After the light from the floodlighting section 19 penetrates the reference filter 38, it is constituted so that it can switch to the reference measurement condition received by the light sensing portion 20.

[0050] As shown in drawing 2, said internal quality analysis processing section 7 is constituted using the microcomputer, and has composition which controls actuation of each part, such as modification accommodation of the supply voltage supplied to a halogen lamp 22, and a switching action of the shutter device of floodlighting section 19 and light sensing portion 20 each, actuation of the vertical regulatory mechanism 37. Moreover, the internal quality analysis processing section 7 is constituted so that data processing which analyzes the internal quality of the measured object M may be performed based on the measurement result obtained with the spectroscope 30.

[0051] The control action by said internal quality analysis processing section 7 is explained. Said internal quality analysis processing section 7 is usually constituted free [a switch in data measurement mode] with criteria data measurement mode. the spectrum which said criteria data measurement mode was performed in advance of the usual measurement to the measured object M, and replaced the light from the floodlighting section 19 with the measured object M, irradiated said reference filter 38, carried out the spectrum of the transmitted light from the reference filter 38 by the light sensing portion 20, received the light which carried out the spectrum, and was obtained -- spectrum data -- criteria -- a spectrum -- it is constituted so that it may ask as spectrum data. moreover, said measured object M by which data measurement mode is usually conveyed by conveyance conveyor 2 -- receiving -- the floodlighting section 19 to light -- irradiating -- measurement -- a spectrum -- spectrum data -- obtaining -- this measurement -- a spectrum -- spectrum data and criteria -- a spectrum -- based on spectrum data, it is constituted so that the internal quality of the measured object M may be analyzed.

[0052] About each above-mentioned mode, explanation is added hereafter. First, in criteria data measurement mode, it is in the condition of stopping conveyance of the measured object M by the conveyance conveyor 2, and the vertical regulatory mechanism 37 is operated and said frame 36 is switched to said reference measurement condition. and the spectrum which switched each shutter device to the open condition, replaced the light from the floodlighting section 19 with the measured object M, irradiated said reference filter 38, carried out the spectrum of the transmitted light from the reference filter 38 by the light sensing portion 20, received the light which carried out the spectrum, and was obtained -- spectrum data -- criteria -- a spectrum -- it measures as spectrum data.

[0053] And in criteria data measurement mode, the detection value (dark current data) of the photo sensor 34 in the non-light condition that the light to a light sensing portion 2 was intercepted is also measured. That is, he switches the shutter device of said light sensing portion 20 to a closed state, and is trying to calculate the detection value in every unit pixel of the photo sensor 34 at that time as dark current data.

[0054] next -- whenever it conveys the object M measured [this / operate / in / usually / data

measurement mode / the vertical regulatory mechanism 37, usually switch a frame 36 to a measurement condition, and according to the conveyance conveyor 2] and each ***** M passes through the part for measurement -- each measurement -- a spectrum -- spectrum data are measured. In addition, the amount of floodlighting in the floodlighting means 19 and charge accumulation-of-electricity time amount of a line sensor are made into the set-up constant value.

[0055] And based on the positional information of the measured object M in the conveyance direction in the conveyance conveyor 2 in case the visual-inspection processing section 6 inspects the appearance of the measured object M, the internal quality analysis processing section 7 manages the positional information of the measured object M to the part 1 for internal quality measurement, and it is constituted so that the floodlighting section 19 and a light sensing portion 20 may be controlled.

[0056] If explanation is added, since the appearance detecting element 5 will detect the appearance information on the measured object M that it is located in the part 4 for visual-inspection measurement While inspecting the appearance of the measured object M based on the detection information on the appearance detecting element 5, the visual-inspection processing section 6 can acquire the positional information of the measured object M in the conveyance direction based on the detection information on the appearance detecting element 5, when it inspects the appearance of the measured object M. And the internal quality analysis processing section 7 manages the positional information of the measured object M to the part 1 for internal quality measurement based on the positional information of the measured object M in the conveyance direction acquired when inspecting the appearance of the measured object M, and it is constituted so that a light projecting/receiving part 3 may operate to the timing to which the measured object M conveyed by conveyance conveyor 2 is located in the part 1 for internal quality measurement.

[0057] Thus, by operating a light projecting/receiving part 3 to the timing located in the part 1 for internal measurement, the internal quality analysis processing section 7 is constituted so that the internal quality of the measured object M may be analyzed by the light which received light with the light projecting/receiving part 3. Therefore, even if it does not establish a positional information detection means to detect the positional information of the measured object M in the conveyance direction etc. While the internal quality analysis processing section 7 can analyze the internal quality of the measured object M and analyzes the internal quality of the measured object M It became possible to aim at reduction of cost and to attain easy-ization of installation and a maintenance, making it possible to inspect the appearance of the measured object M.

[0058] When inspecting the appearance of the measured object M, specifically, the visual-inspection processing section 6 is constituted so that the positional information of the measured object M of the timing to which the measured object M passed through the part for visual-inspection measurement, i.e., the conveyance direction, may be acquired from the photography timing of the measured object M by color CCD camera 9 etc. Moreover, the internal quality analysis processing section 7 is constituted so that it may ask for the timing to which the conveyance direction mid gear of each ***** M conveyed in the part 1 for internal quality measurement passes through the part 1 for internal quality measurement based on the positional information of the measured object M in the conveyance direction acquired in the visual-inspection processing section 6, and the bearer rate of the conveyance conveyor 2 detected by the rotary encoder 39.

[0059] Incidentally about the bearer rate of the conveyance conveyor 2 Since it is set up so that one measured object M may pass through the range of an image pick-up field by the setup time (for example, for about 1 second) The conveyance direction mid gear of each ***** M conveyed as the set-up bearer rate in the part 1 for internal quality measurement, without forming a rotary encoder 39 is possible also for asking for the timing which passes through the part 1 for internal quality measurement.

[0060] The conveyance direction mid gear of the measured object M the internal quality analysis processing section 7 rather than the timing which passes through the part for measurement and from before the setup time Time amount until the conveyance direction mid gear of the measured object M carries out setup-time progress from the timing which passes through the part for measurement is set up with the charge accumulation-of-electricity time amount of a line sensor. whenever each ***** M

passes through the part for measurement -- the light income of each photo sensor 18 -- measuring -- measurement -- a spectrum -- he is trying to measure spectrum data In addition, before measuring the light income of a photo sensor 18, empty reading actuation which carries out empty reading of the detection value of a photo sensor 18 is performed, and you may make it extract the charge which the capacitor has already stored electricity.

[0061] Said internal quality analysis processing section 7 is constituted so that data processing which analyzes the internal quality of the measured object M using the spectral-analysis technique based on the various data obtained by doing in this way may be performed. namely, measurement -- a spectrum -- spectrum data and criteria -- a spectrum -- while acquiring the quadratic differential value in the wavelength field of the absorbance spectrum for every wavelength by which the spectrum was carried out, and an absorbance spectrum based on spectrum data and dark current data, it is constituted so that analysis data processing which computes the amount of components corresponding to the sugar content contained in the measured object M by the quadratic differential value and the amount of components corresponding to acidity may be performed. an absorbance d -- criteria -- a spectrum -- spectrum data -- Rd and measurement -- a spectrum -- if spectrum data are set to Sd and dark current data are set to Da --

[0062]

[Equation 4]

$$d = \log \{ (Rd - Da) / (Sd - Da) \}$$

[0063] Coming out and defining, the internal quality analysis processing section 7 computes the amount of components contained in the measured object M based on the multiple regression analysis by following several 5.

[0064]

[Equation 5]

$$Y = K0 + K1 \cdot A(\lambda 1) + K2 \cdot A(\lambda 2)$$

[0065] However, Y ; The amounts K0, K1, and K2 of components ; A coefficient A (lambda 1), A (lambda 2) ; quadratic differential value of the absorbance spectrum in the specific wavelength lambda

[0066] In addition, for every component which computes the amount of components, the specific amount formula of components, the specific multipliers K0, K1, and K2, wavelength lambda1 and lambda2, etc. are beforehand set up by the internal quality analysis processing section 7, it memorizes, and it has at it the composition of computing the amount of components of each component using the specific amount formula of components for every component of this.

[0067] The [2nd operation gestalt] In the above-mentioned 1st operation gestalt, this 2nd operation gestalt shows another operation gestalt about the control action at the time of the internal quality analysis processing section 7 analyzing the internal quality of the measured object M, and explains the control action of that internal quality analysis processing section 7. In addition, with this 2nd operation gestalt, since it is the same as that of the above-mentioned 1st operation gestalt about the configuration of others other than the control action of the above-mentioned internal quality analysis processing section 7, that explanation is omitted by the above-mentioned 1st operation gestalt and a same sign being shown etc.

[0068] Said internal quality analysis processing section 7 is constituted so that the measurement conditions when analyzing the internal quality of the measured object M may be adjusted based on the detection information on the appearance detecting element 5. That is, the internal quality analysis processing section 7 is constituted so that the amount of light emitting/receiving by the light projecting/receiving part 3 when analyzing the internal quality of the measured object M may be adjusted based on the detection information on the appearance detecting element 5.

[0069] If the appearance of the measured objects M, such as a configuration of the measured object M and magnitude, generally changes that the quantity of light of the transmitted light of the measured object M will decrease, so that the magnitude of the measured object M becomes large for example, if explanation is added etc. The quantity of light of the transmitted light of the measured object M will change, and the transmitted light of the measured object M of a setting proper amount cannot be received by the light sensing portion 20, but there is a possibility that the internal quality of the

measured object M may be immeasurable with a sufficient precision. Then, the amount of light emitting/receiving by the light projecting/receiving part 3 in case the internal quality analysis processing section 7 analyzes the internal quality of the measured object M based on appearance information acquired from the detection information on the appearance detecting element 5, such as a configuration of the measured object M and magnitude, is adjusted. According to the appearance information on the measured object M, it is constituted so that the light of a setting proper amount may be received with a light projecting/receiving part 3, and the amount of light emitting/receiving of a light projecting/receiving part 3 may be adjusted.

[0070] That is, in order that precision may improve internal quality of the measured object M, even if it does not establish a means of detection detect the appearance information on the measured object M, using the appearance information on the measured object M obtained when inspecting the appearance of the measured object M, the amount of light emitting/receiving of a light projecting/receiving part 3 is adjusted, and it is constituted so that the transmitted light of the measured object M of a setting proper amount may be received with a light projecting/receiving part 3. Since the visual-inspection processing section 6 will inspect the appearance of the measured object M based on the detection information on the appearance detecting element 5, specifically In that case, appearance information, such as a configuration of the measured object M and magnitude, can be acquired. The internal quality analysis processing section 7 Based on the appearance information on the obtained measured object M, it is constituted so that the magnitude of the measured object M is large, and floodlighting reinforcement by the floodlighting section 19 may be enlarged, and modification accommodation of the supply voltage supplied to a halogen lamp 6 may be carried out.

[0071] Moreover, like the above-mentioned 1st operation gestalt, based on the positional information of the measured object M in the conveyance direction in the conveyance conveyor 2 in case the visual-inspection processing section 6 inspects the appearance of the measured object M, the internal quality analysis processing section 7 manages the positional information of the measured object M to the part 1 for internal quality measurement, and it is constituted so that the floodlighting section 19 and a light sensing portion 20 may be controlled.

[0072] Incidentally with this 2nd operation gestalt, the optical passage sensor which detects passage of the measured object M is formed in the upstream rather than the part for internal quality measurement in the conveyance direction of the conveyance conveyor 2. The internal quality analysis processing section 7 The detection information on said passage sensor, It is also possible to constitute and carry out so that it may ask for the timing to which the conveyance direction mid gear of each ***** M conveyed in the part 1 for internal quality measurement passes through the part 1 for internal quality measurement based on the detection information on a rotary encoder 39.

[0073] The [3rd operation gestalt] In the above-mentioned 2nd operation gestalt, this 3rd operation gestalt shows another operation gestalt about the control action at the time of the internal quality analysis processing section 7 analyzing the internal quality of the measured object M, and explains the control action of that internal quality analysis processing section 7. In addition, with this 3rd operation gestalt, since it is the same as that of the above-mentioned 2nd operation gestalt about the configuration of others other than the control action of the above-mentioned internal quality analysis processing section 7, that explanation is omitted by the above-mentioned 2nd operation gestalt and a same sign being shown etc.

[0074] Said internal quality analysis processing section 7 is constituted so that the measurement conditions when analyzing the internal quality of the measured object M may be adjusted based on the detection information on the appearance detecting element 5. That is, based on the magnitude information on the measured object M in the detection information on the appearance detecting element 5, the internal quality analysis processing section 7 is constituted so that the relative-position relation between the part 1 for internal quality measurement and a light projecting/receiving part 3 may be adjusted.

[0075] When explanation was added, for example the relative-position relation between the part 1 for internal quality measurement and a light projecting/receiving part 3 is fixed to the relative-position

relation suitable for what has the large magnitude of the measured object M. If the magnitude of the measured object M becomes small, the light which turns around the measured object M among the light which irradiated the measured object 1 will arise. The light around which it turned will be received with a light projecting/receiving part 3, an S/N (signal pair noise) ratio becomes small, and there is a possibility that the internal quality of the measured object M may be immeasurable with a sufficient precision. Then, the internal quality analysis processing section 7 adjusts the relative-position relation between the part 1 for internal quality measurement, and a light projecting/receiving part 3 based on the magnitude information on the measured object M in the detection information on the appearance detecting element 5, and it is constituted so that the light to which the light projecting/receiving part 3 turned around the measured object M may not be received according to the magnitude of the measured object M.

[0076] Namely, in order that precision may improve internal quality of the measured object M, even if it does not establish a means of dedication to detect the magnitude information on the measured object M, the magnitude information on the measured object M obtained when inspecting the appearance of the measured object M is used. The relative-position relation between the part 1 for internal quality measurement and a light projecting/receiving part 3 is adjusted, and it is constituted so that the light to which the light projecting/receiving part 3 turned around the measured object M may not be received.

[0077] Since the visual-inspection processing section 6 will inspect the appearance of the measured object M based on the detection information on the appearance detecting element 5, specifically In that case, the magnitude information on the measured object M can be acquired. The internal quality analysis processing section 7 Based on the magnitude information on the obtained measured object M, as shown in drawing 11 It adjusts by the vertical regulatory mechanism 37 so that a light projecting/receiving part 3 may be arranged at an upper part side, and it is constituted so that the measured object M may be irradiated in the floodlighting section 19 focusing on the central part of the measured object M, so that the magnitude of the measured object M is large.

[0078] Incidentally it sets in this 3rd operation gestalt. The internal quality analysis processing section 7 While adjusting the relative-position relation between the part 1 for internal quality measurement, and a light projecting/receiving part 3 based on the magnitude information on the measured object M in the detection information on the appearance detecting element 5 By adjusting the amount of light emitting/receiving by the light projecting/receiving part 3 when analyzing the internal quality of the measured object M like the above-mentioned 2nd operation form attitude based on the detection information on the appearance detecting element 5 It is also possible to constitute so that the measurement conditions when analyzing the internal quality of the measured object M may be adjusted based on the detection information on the appearance detecting element 5.

[0079] Moreover, like the above-mentioned 1st operation gestalt, based on the positional information of the measured object M in the conveyance direction in the conveyance conveyor 2 in case the visual-inspection processing section 6 inspects the appearance of the measured object M, the internal quality analysis processing section 7 manages the positional information of the measured object M to the part 1 for internal quality measurement, and it is constituted so that the floodlighting section 19 and a light sensing portion 20 may be controlled.

[0080] Incidentally with this 3rd operation gestalt, the optical passage sensor which detects passage of the measured object M is formed in the upstream rather than the part for internal quality measurement in the conveyance direction of the conveyance conveyor 2. The internal quality analysis processing section 7 The detection information on said passage sensor, It is also possible to constitute and carry out so that it may ask for the timing to which the conveyance direction mid gear of each ***** M conveyed in the part 1 for internal quality measurement passes through the part 1 for internal quality measurement based on the detection information on a rotary encoder 39.

[0081] [Another operation gestalt]

(1) What is necessary is to be able to be adapted in various kinds of image pick-up means, such as what obtains the camera and the monochrome image of the formula between image pick-ups, and just to be able to detect the appearance information on the measured object M as an appearance detecting element

5, although the above-mentioned operation gestalt showed the example which used color CCD camera 9 as an appearance detecting element 5.

[0082] (2) Although the above-mentioned operation gestalt showed the example which constitutes the floodlighting section 19 and a light sensing portion 20 for a light projecting/receiving part 3 in each **, it is also possible to constitute and carry out a light projecting/receiving part 3 with one light projecting/receiving part.

[0083] (3) Although charge accumulation-of-electricity time amount of the line sensor as a photo sensor is made into the set-up constant value with the above-mentioned operation gestalt, you may make it, change the charge accumulation-of-electricity time amount of a line sensor for example, according to measurement conditions, such as a form of the measured object M, and magnitude.

[0084] (4) Although the spectrum of the light received with the light projecting/receiving part 3 was carried out, and it constituted from an above-mentioned operation gestalt based on optical spectrum data that much so that the internal quality of the measured object M might be analyzed It does not restrict to the approach using spectral analysis, and you may make it analyze the internal quality of the measured object M about the approach of analyzing the internal quality of the measured object M, using various kinds of analysis approaches.

[0085] (5) Although the conveyance conveyor 2 was considered as the configuration which drives endless rotation band 2a with electric motor 2b with the above-mentioned operation gestalt, various kinds of conveyance means, such as constituting the conveyance conveyor 2 in a roller conveyor, can be adapted.

[0086] (6) Although the bearer rate of the conveyance conveyor 2 was set up with the above-mentioned 1st operation gestalt so that one measured object M might pass through the range of an image pick-up field by the setup time (for example, for about 1 second), you may constitute possible [modification of the bearer rate of the conveyance conveyor 2], and he is trying to adjust the image pick-up timing by color CCD camera 9 in this case based on the detection information on a rotary encoder 39.

[0087] (7) Although it constituted from an above-mentioned 2nd operation gestalt so that supply voltage might be adjusted and the floodlighting reinforcement by the floodlighting section 19 might be adjusted based on the appearance information on the measured object M obtained when inspecting the appearance of the measured object M For example, the diaphragm device equipped with two or more converging sections with which the amounts of diaphragms differ is established by making the amount of floodlighting by the floodlighting section 19 into a constant rate. It is also possible to constitute and carry out so that the light from the floodlighting section 19 may be extracted and the amount of diaphragms by the device may be adjusted based on the appearance information on the measured object M obtained when inspecting the appearance of the measured object M. Moreover, it replaces with a diaphragm device and you may make it establish the extinction device equipped with two or more extinction objects with which the amounts of extinction differ in this case.

[0088] (8) Although it constituted from an above-mentioned 3rd operation gestalt so that the location of the vertical direction might be adjusted for the floodlighting section 19 and a light sensing portion 20 and the relative-position relation between the part 1 for internal quality measurement and a light projecting/receiving part 3 might be adjusted based on the magnitude information on the measured object M obtained when inspecting the appearance of the measured object M It is also possible to constitute so that a lateral location may be adjusted for the floodlighting section 19 and a light sensing portion 20 and the relative-position relation between the part 1 for internal quality measurement and a light projecting/receiving part 3 may be adjusted based on the magnitude information on the measured object M.

[0089] (9) With the above-mentioned operation gestalt, although the filter by opal glass was used as a criteria object, the quality of the material is not limited that what is necessary is just what has a predetermined absorbance property besides diffusion plates, such as not only this but an obscured glass. Moreover, you may make it a photo sensor also use other detection means, such as not only an MOS mold line sensor but a CCD mold line sensor.

[0090] (10) the above-mentioned operation gestalt -- the transmitted light from the measured object M --

being based -- a spectrum -- although it constituted so that a spectrum might be measured -- this configuration -- replacing with -- the reflected light from the measured object M -- being based -- a spectrum -- it is also possible to constitute and carry out so that a spectrum may be measured.

[0091] (11) With the above-mentioned operation gestalt, as internal quality of the measured object M, although a sugar content and acidity were illustrated, the other internal quality, such as information not only on this but a flavor, may be measured.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] A conveyance means to convey a measured object is established so that it may pass through the part for internal quality measurement, and this invention irradiates light at said measured object located in said part for internal quality measurement. It is related with evaluation equipment equipped with the control means which analyzes the internal quality of said measured object by the light which controlled actuation of a light emitting/receiving means to receive the transmitted light or the reflected light from said measured object, and its light emitting/receiving means, and received light with said light emitting/receiving means.

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PRIOR ART

[Description of the Prior Art] The internal quality evaluation equipment to which the above evaluation equipments analyze the internal quality of a measured object by the light which the light emitting/receiving means was operated so that light might be irradiated at the measured object and the transmitted light or the reflected light from the measured object might be received, when measured objects, such as garden stuff, passed through the part for internal quality measurement, and received light with the light emitting/receiving means is formed. And after [for example,] carrying out the spectrum of the transmitted light or the reflected light from a measured object in a concave grating, The line sensor of the charge accumulation-of-electricity type which arranged in in the shape of an array the photo detector which consists of two or more optoelectric transducers etc. is used as a light emitting/receiving means. the spectrum measured with such a light emitting/receiving means -- the spectrum measured with a light emitting/receiving means since the internal quality of measured objects, such as garden stuff, is reflected in spectrum data -- based on spectrum data, the internal quality of measured objects, such as garden stuff, is analyzed.

[0003] From it being required to operate a light emitting/receiving means to the timing to which the measured object conveyed with a conveyance means is located in the part for internal quality measurement with said internal quality evaluation equipment In the conveyance direction of the measured object in a conveyance means rather than the part for internal quality measurement to the upstream For example, a positional information detection means to detect the positional information of the measured object in the conveyance directions, such as a position sensor which detects that the measured object passed, is established. He manages the positional information of the measured object to the part for internal quality measurement, and is trying to operate a light emitting/receiving means to exact timing based on the detection information on the positional information detection means. Moreover, if internal quality evaluation equipment changes a configuration, magnitude, etc. of a measured object Since there is a possibility that the quantity of light of the transmitted light from a measured object or the reflected light can change, light of a setting proper amount cannot be received with a light emitting/receiving means, and internal quality of a measured object cannot be measured with a sufficient precision From to adjust the measurement conditions when analyzing the internal quality of a measured object according to a configuration, magnitude, etc. of a measured object being desired He establishes the detection means for acquiring information, such as a configuration of a measured object, and magnitude, and is trying to adjust the measurement conditions when analyzing the internal quality of a measured object based on the detection information on the detection means.

[0004] While conveying a measured object with this kind of evaluation equipment so that it may pass through the part for visual-inspection measurement with a conveyance means An appearance detection means to detect the appearance information on a measured object that it is located in the part for visual-inspection measurement is established. In addition to above-mentioned internal quality equipment, based on the detection information on an appearance detection means, the visual-inspection equipment which inspects the appearance of a measured object is formed, and, in addition to the analysis of the internal quality of a measured object, there is a thing he is trying to inspect the appearance of a measured object.

An image pick-up means to picturize for example, a measured object is used for this visual-inspection equipment as an appearance detection means. While an image pick-up means is operated so that the measured object located in the part for visual-inspection measurement may be picturized, and acquiring the positional information of the measured object in the conveyance direction based on the image information of the image pick-up means Appearance information, such as a configuration of a measured object and magnitude, is acquired, and it is constituted so that the appearance configuration of a measured object may inspect normal, abnormalities, etc.

[0005] Although he is trying to inspect the appearance of a measured object while forming the internal quality evaluation equipment which analyzes the internal quality of a measured object, and the visual-inspection equipment which inspects the appearance of a measured object with this kind of evaluation equipment and analyzing the internal quality of a measured object like **** For example, various kinds of information, such as a configuration, magnitude, etc. of the positional information of the measured object in the conveyance direction or a measured object, is managed by each ** by each of internal quality evaluation equipment and visual-inspection equipment, and he is trying to control these two equipments to each **.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, with above evaluation equipment, various kinds of information, such as a configuration, magnitude, etc. of the positional information of the measured object in the conveyance direction or a measured object, is managed by each ** by each of internal quality evaluation equipment and visual-inspection equipment. Since these two equipments are controlled by each **, it is necessary to form the detection means for detecting various kinds of information etc. in each equipment. To eye others While components mark, such as a detection means, increase and causing a cost rise, there is a possibility that installation and a maintenance may become troublesome.

[0007] This invention is in the point of offering the evaluation equipment which becomes possible [aiming at reduction of cost and attaining easy-ization of installation and a maintenance], making it possible to inspect the appearance of a measured object while it is made paying attention to this point and analyzes the internal quality of a measured object.

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3. In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] In order to attain this purpose, according to invention according to claim 1, a conveyance means to convey a measured object is established so that it may pass through the part for internal quality measurement, and light is irradiated at said measured object located in said part for internal quality measurement. In evaluation equipment equipped with the control means which analyzes the internal quality of said measured object by the light which controlled actuation of a light emitting/receiving means to receive the transmitted light or the reflected light from said measured object, and its light emitting/receiving means, and received light with said light emitting/receiving means An appearance detection means to detect the appearance information on said measured object that it is located in the part for visual-inspection measurement of the upstream rather than said part for internal quality measurement in the conveyance direction of said measured object in said conveyance means is established. While inspecting the appearance of said measured object based on the detection information on said appearance detection means, said control means Based on the positional information of said measured object in said conveyance direction when inspecting the appearance of the measured object, the positional information of said measured object to said part for internal quality measurement is managed, and it is constituted so that said light emitting/receiving means may be controlled.

[0009] Namely, since an appearance detection means detects the appearance information on a measured object that it is located in the part for visual-inspection measurement of the upstream rather than the part for internal quality measurement in the conveyance direction of a measured object While inspecting the appearance of a measured object based on the detection information on an appearance detection means, a control means becomes possible [acquiring the positional information of the measured object in the conveyance direction] based on the detection information on an appearance detection means, when it inspects the appearance of a measured object. And since the control means is constituted based on the positional information of the measured object in the conveyance direction acquired when inspecting the appearance of a measured object so that the positional information of the measured object to the part for internal quality measurement may be managed, it becomes possible to operate a light-emitting/receiving means of the measured object conveyed with a conveyance means to the timing located in the part for internal quality measurement. Thus, a control means becomes possible [analyzing the internal quality of said measured object by the light which received light with the light emitting/receiving means] by operating a light emitting/receiving means to the timing located in the part for internal measurement. [0010] Therefore, even if it does not establish a positional information detection means to detect the positional information of the measured object in the conveyance direction etc. The measured object with which a control means is conveyed with a conveyance means using the positional information of the measured object in the conveyance direction acquired when inspecting the appearance of a measured object operates a light emitting/receiving means to the timing located in the part for internal quality measurement, and becomes possible [analyzing the internal quality of a measured object].

[0011] It was able to come to offer the evaluation equipment which becomes possible [aiming at reduction of cost and attaining easy-ization of installation and a maintenance from the above thing, making it possible to inspect the appearance of a measured object, while analyzing the internal quality of

a measured object according to invention according to claim 1,].

[0012] According to invention according to claim 2, a conveyance means to convey a measured object is established so that it may pass through the part for internal quality measurement, and light is irradiated at said measured object located in said part for internal quality measurement. In evaluation equipment equipped with the control means which analyzes the internal quality of said measured object by the light which controlled actuation of a light emitting/receiving means to receive the transmitted light or the reflected light from said measured object, and its light emitting/receiving means, and received light with said light emitting/receiving means An appearance detection means to detect the appearance information on said measured object that it is located in the part for visual-inspection measurement of the upstream rather than said part for internal quality measurement in the conveyance direction of said measured object in said conveyance means is established. While said control means inspects the appearance of said measured object based on the detection information on said appearance detection means, it is constituted so that the measurement conditions when analyzing the internal quality of said measured object may be adjusted based on the detection information on said appearance detection means.

[0013] That is, since an appearance detection means detects the appearance information on a measured object are located in the part for visual-inspection measurement of the upstream rather than the part for internal quality measurement in the conveyance direction of a measured object, a control means becomes possible [acquiring appearance information, such as the configuration of a measured object, and magnitude, from the detection information on an appearance detection means], while inspecting the appearance of a measured object based on the detection information on an appearance detection means. And since the control means is constituted so that the measurement conditions when analyzing the internal quality of a measured object may be adjusted based on the appearance information on the measured object obtained when inspecting the appearance of a measured object A control means becomes possible [adjusting the measurement conditions when analyzing the internal quality of a measured object to the measurement conditions which become possible / measuring the internal quality of a measured object with a sufficient precision / according to the appearance information on a measured object].

[0014] Therefore, even if it does not establish the detection means for acquiring information, such as a configuration of a measured object, and magnitude A control means adjusts the measurement conditions when analyzing the internal quality of a measured object according to the appearance information on a measured object using the appearance information on the measured object obtained from the detection information on an appearance detection means, and becomes possible [measuring the internal quality of a measured object with a sufficient precision].

[0015] It was able to come to offer the evaluation equipment which becomes possible [aiming at reduction of cost and attaining easy-ization of installation and a maintenance from the above thing, making it possible to inspect the appearance of a measured object, while analyzing the internal quality of a measured object according to invention according to claim 2,].

[0016] According to invention according to claim 3, said control means is constituted so that the amount of light emitting/receiving by said light emitting/receiving means when analyzing the internal quality of said measured object may be adjusted based on the detection information on said appearance detection means.

[0017] That is, when the amount of light emitting/receiving by the light emitting/receiving means when analyzing the internal quality of a measured object is being fixed to a constant rate for example, and the appearance of a measured object changes, the light income by the light emitting/receiving means changes, and light of a setting proper amount cannot be received with a light emitting/receiving means, but there is a possibility that the internal quality of a measured object may be immeasurable with a sufficient precision. Since the control means is constituted to it based on appearance information acquired from the detection information on an appearance detection means, such as a configuration of a measured object, and magnitude, so that the amount of light emitting/receiving by the light emitting/receiving means when analyzing the internal quality of a measured object may be adjusted According to the appearance information on a measured object, it becomes possible to adjust the amount

of light emitting/receiving of a light emitting/receiving means so that the light of a setting proper amount may be received with a light emitting/receiving means. Therefore, even if the appearance of a measured object changes, it becomes possible in the condition corresponding to the change to analyze the internal quality of a measured object, and it becomes possible to measure the internal quality of a measured object with a much more sufficient precision.

[0018] According to invention according to claim 4, based on the magnitude information on said measured object in the detection information on said appearance detection means, said control means is constituted so that the relative-position relation of said part for internal quality measurement and said light emitting/receiving means may be adjusted.

[0019] Namely, when [of for example the part for internal quality measurement, and a light emitting/receiving means] the magnitude of a measured object fixes relative-position relation to proper relative-position relation to a large thing When the magnitude of a measured object becomes small, the light which turns around a measured object among the light which irradiated the measured object will arise, the light around which it turned will be received with a light emitting/receiving means, an S/N (signal pair noise) ratio becomes small, and there is a possibility that the internal quality of a measured object may be immeasurable with a sufficient precision. Since the control means is constituted to it based on the magnitude information on the measured object in the detection information on an appearance detection means so that the relative-position relation between the part for internal quality measurement and a light emitting/receiving means may be adjusted It becomes possible to adjust the relative-position relation between the part for internal quality measurement, and a light emitting/receiving means so that the light to which the light emitting/receiving means turned around the measured object may not be received according to the magnitude of a measured object. Therefore, even if the magnitude of a measured object changes, it becomes possible in the condition corresponding to the change to analyze the internal quality of a measured object, and it becomes possible to measure the internal quality of a measured object with a much more sufficient precision.

[0020]

[Embodiment of the Invention] About the evaluation equipment concerning this invention, it prepares for the fruit-sorting facility which performs sorting classification of a mandarin orange as a measured object, magnitude, the appearance, i.e., the appearance configuration, of a mandarin orange, etc. is inspected, and the case where it applies to the configuration which measures the internal quality information of a mandarin orange, i.e., a sugar content, acidity, etc., is explained based on a drawing.

[0021] The [1st operation gestalt] The conveyance conveyor 2 as a conveyance means to convey the measured object M (mandarin orange) so that this evaluation equipment may pass through the part 1 for internal quality measurement, as shown in drawing 1 , The light projecting/receiving part 3 as a light emitting/receiving means to irradiate light at the measured object M located in the part 1 for internal quality measurement, and to receive the transmitted light from the measured object M, In the conveyance direction of the measured object M in the conveyance conveyor 2, the appearance detecting element 5 as an appearance detection means to detect the appearance information on the measured object M that it is located in the part 4 for visual-inspection measurement of the upstream etc. is formed, and it consists of parts 1 for internal quality measurement.

[0022] And the control section 8 as a control means equipped with the internal quality analysis processing section 7 which analyzes the internal quality of the measured object M by the light which this evaluation equipment controlled actuation of the visual-inspection processing section 6 which inspects appearances, such as an appearance configuration of the measured object M and magnitude, and a light projecting/receiving part 3 based on the detection information on the appearance detecting element 5, and received light with the light projecting/receiving part 3 is formed. Moreover, based on the positional information of the measured object M in the conveyance direction acquired when the visual-inspection processing section 6 inspects the appearance of the measured object M, the internal quality analysis processing section 7 manages the positional information of the measured object M to the part 1 for internal quality measurement, and it is constituted so that the light emitting/receiving means 3 may be controlled.

[0023] Moreover, the measured object M is constituted so that it may have become column-like by the single tier at the setting rate with the configuration by which installation conveyance is carried out and may pass through the part 4 for visual-inspection measurement, and the part 1 for internal quality measurement one by one by conveyance conveyor 2. Said conveyance conveyor 2 has the composition of driving endless rotation band 2a with electric motor 2b, it has the rotary encoder 39 which detects the rotation condition of the revolving shaft of body-of-revolution 2c which winds that endless rotation band 2a, and the detection information on this rotary encoder 39 has the composition of being inputted into a control section 8.

[0024] First, the visual inspection of the measured object M in the part 4 for visual-inspection measurement is explained. As shown in drawing 3, drawing 4, and drawing 5, the lighting section 10 illuminated to the measured object M used as the candidate for an image pick-up by the color-type color CCD camera 9 and color CCD camera 9 of 3 plate type is formed, and said visual-inspection section 5 is constituted so that said visual-inspection processing section 6 may distinguish the fault part of the measured object M based on the image information of color CCD camera 9. In addition, the setting means 11 for carrying out an artificial setup of the criteria information for visual inspection etc. to the visual-inspection processing section 6 is established.

[0025] Said lighting section 10 is constituted so that the reflected light of a light strong against the specific direction may not be generated to the measured object M and it may become indirect lighting on the occasion of photography by color CCD camera 9. That is, color CCD camera 9 is attached in the interior of the housing form reflective cover object 13 located in the upper part side of the conveyance conveyor 2 while applying a reflective paint to a wall and forming the reflective barrier side 12 through support 14, and the light source 16 for lighting which equipped with the curve mold reflecting plate 15 the perimeter section (four places) which separated predetermined spacing to color CCD camera 9 is supported through the support arm 17.

[0026] And since the measured object M which what was reflected in respect of [12] the reflective barrier once formed in the upper part peripheral wall, and the light which reflected with the curve mold reflecting plate 15, and was further reflected by the upper part peripheral wall are compounded, and this reflected light by which reflective diffusion was carried out covers, and is located under the body 13 irradiates without the illumination light from the light source 16 reaching the measured object M of a direct lower part, it is constituted so that it may become uniform and soft indirect lighting.

Consequently, there is no disadvantage, such as acquiring image pick-up information as information which originated in the strong reflected light of the specific direction, and was mistaken, and the exact measured object M can be picturized. Moreover, photography of the measured object M by color CCD camera 9 is constituted so that it not only radiographs from an upper part side, but the image pick-up information on the right-and-left both-sides section of the measured object M may be acquired through the reflecting mirror 18 arranged in the conveyance direction both-sides section.

[0027] In addition, the bearer rate of the conveyance conveyor 2, the relative position of color CCD camera 9 to an image pick-up field, etc. are set up so that the measured object M of plurality (for example, five pieces) may be picturized by coincidence and, as for the photography visual field (image pick-up field) of the measured object M by color CCD camera 9, one measured object M may pass through the range of this image pick-up field by the setup time (for example, for about 1 second). Incidentally, about the bearer rate of the conveyance conveyor 2, since it is detectable with a rotary encoder 39, it is also possible to adjust the image pick-up timing by color CCD camera 9 based on the detection information on the rotary encoder 39. Moreover, in order to obtain the static image to the measured object M which is moving continuously, while it has a high-speed electronic shutter and the measured object M passes through the inside of said image pick-up field, color CCD camera 9 is constituted so that two or more division images which divided the perimeter of the measured object M into plurality can be obtained and image incorporation processing can be performed.

[0028] As shown in drawing 2, said visual-inspection processing section 6 is constituted using a microcomputer, and it is constituted so that an image processing may be performed to the picture signal (R, G, B) in three primary colors outputted from color CCD camera 9. And the visual-inspection

processing section 6 is based on the image pick-up image of color CCD camera 9. The saturation information showing the saturation of the measured object M, the lightness information showing the lightness of the measured object M, It asks for each showing the chromaticity of the measured object M of chromaticity information. And such saturation information, It is constituted so that fault partial distinction processing which distinguishes the appearance information on the measured object M, for example, the upper limit, distortion of an appearance, etc., may be performed based on the appearance distinction processing and the image pick-up image of color CCD camera 9 which distinguish the fault part of the measured object M based on lightness information and chromaticity information.

[0029] If explanation is added about the control action of said visual-inspection processing section 6, the picture signal (R, G, B) in three primary colors outputted from color CCD camera 9 will be inputted, and HSI transform processing which changes a picture signal into the information showing each information on a chromaticity (H), saturation (S), and lightness (I) will be performed based on the picture signal (R, G, B) in three primary colors. To the picture signal (R, G, B) in three primary colors outputted from color CCD camera 9, data processing will be performed based on the operation expression by following [several 1]- [several 3], and, specifically, the output corresponding to each of a chromaticity (H), saturation (S), and lightness (I) will be obtained.

[0030]

[Equation 1] $I=0.3R+0.59G+0.11B$ [0031]

[Equation 2] $H=\tan^{-1}(C1/C2)$

(However, $C1=R-I$, $C2=B-I$)

[0032]

[Equation 3] $S=\sqrt{C1^2+C2^2}$

(However, $C1=R-I$, $C2=B-I$)

[0033] Next, based on the above-mentioned HSI conversion print-out, by the comparison with the setting threshold beforehand set up to each signal etc., the field of the measured object M in an image is extracted, and appearance distinction processing of the inspected object M is performed based on the image information of the extracted measured object M. As shown in drawing 6, while said appearance distinction processing extracts the profile L of the appearance of the measured object M About the distance to the point of asking for the center-of-gravity location G of the profile L by the operation, and being located on a profile L from the center-of-gravity location G The change condition in the direction which meets a profile L is searched for with the Fourier transform, and based on the change condition of the distance, the appearance configuration of the measured object M is unusual, or (is there any distortion?) distinguishes whether it is no.

[0034] If it explains concretely, as shown in drawing 7, it can express from distance r and a center-of-gravity location as a function with the include angle theta of the line and the datum line which connect a profile to make as a change condition in the direction which meets the profile L about the distance to the point of being located on a profile L from the center-of-gravity location G. at this time, the front face of a measured object is smooth -- becoming a curve intense [of change of the function of drawing 7], if irregularity exists [the front face of a measured object], although it will become only the low frequency component of spatial frequency if a function also becomes a smooth curve as it is shown in (b) of drawing 7, if circular, and it asks for that Fourier transform, the Fourier transform comes to contain many high-frequency components of spatial frequency f. Therefore, distortion of the appearance configuration of a measured object can be distinguished by distinguishing the condition of such a high-frequency component.

[0035] Moreover, the overall diameter of the measured object M is distinguished based on the information on a profile L. In addition, although the image of two or more measured objects will exist in fact on an image pick-up image, in drawing 6, it is indicated that only one image information is intelligible.

[0036] Next, based on the above-mentioned HSI conversion print-out, fault partial distinction processing which distinguishes the fault part of the measured object M is performed. This fault partial distinction processing sets up the target pixel among two or more pixels which can be first set to the field extracted

as a field of the measured object M. The value of the saturation (S) in the pixel distinguishes that it is smaller than the setting saturation threshold S0 set up beforehand, and lightness (I) is [the pixel] a fault part when smaller than the 1st set point I1. That is, it is because the front face of the measured object M has discolored black or a case as dirty black can be considered according to causes -- saturation (S) is low, and lightness (I) pokes with a bird in being quite low.

[0037] moreover, the setting saturation threshold S0 to which the value of saturation (S) was set beforehand -- small -- and lightness (I) -- the 1st -- more than set point I1 -- the 2nd -- in being in the setting range which is less than [set point I2], it distinguishes that the pixel is a fault part. That is, it is because the case where it is in the water corrosion condition etc. can be considered when it originates in disease etc. when saturation (S) is low and lightness (I) is in an in-between setting range, and the front face is in the "slough" condition or.

[0038] In addition, since lightness (I) can remain [drugs etc.] in the front face of for example, the measured object M when larger than the 2nd set point I2, or the fall of the saturation by the variation in lighting etc. can be considered, he is trying not to distinguish from fault in such a case, even if it is the case that the value of saturation (S) is smaller than the setting saturation threshold S0 set up beforehand. When not distinguished from fault, it distinguishes as normal, and it performs about all the pixels of the field from which such distinction actuation was extracted.

[0039] When the part distinguished from fault by processing which was described above is equipped with specific conditions, moreover, specifically A part with low saturation is an approximate circle form, and to the outer diameter of the measured object M, in being close to the magnitude of a predetermined rate, it judges that such a part is a part called HETA and HESO of the measured object M (mandarin orange), and suppose that such a part is excepted from fault.

[0040] Next, the average of the saturation in all the pixels (except for the parts of said HETA and HESO) in the field of a measured object is calculated by the operation, and the average saturation and the standard saturation set up beforehand are measured. With this standard saturation, it is set up as follows. That is, generally a chromaticity (H) and saturation (S) have the correlation. For example, it is in the inclination for saturation to become high in the case of the chromaticity of a bright color tone.

[0041] Then, the general correlation of such a chromaticity and saturation in the measured object M used as a subject of examination (mandarin orange) is measured beforehand, the saturation which has the above-mentioned correlation corresponding to the actually measured chromaticity is set up as standard saturation by the result picturized by color CCD camera 9, and the average of all the pixels of the measured object M of this standard saturation and the actually measured saturation is compared. And since a case in being low, as average saturation of the front face of the measured object M has withered more than the amount of setup rather than standard saturation, for example can be considered, it distinguishes as fault.

[0042] The analysis of the internal quality of the measured object M in said part 1 for internal quality measurement is explained. the floodlighting section 19 to which said light projecting/receiving part 3 irradiates light at the measured object M (mandarin orange) as shown in drawing 8 , and the light in which the measured object M was penetrated -- a spectrum -- carrying out -- the light which carried out the spectrum -- receiving light -- a spectrum -- it consists of light sensing portions 20 which obtain spectrum data. Moreover, after the light projected from the floodlighting section 19 penetrates the measured object M to the measured object M located in the part 1 for internal quality measurement, in the condition that light is received by the light sensing portion 20, the floodlighting section 19 and a light sensing portion 20 distribute to the right-and-left both-sides part of the part 1 for internal quality measurement, and are arranged.

[0043] The reflecting mirror 24 sideways changed towards the measured object M which said floodlighting section 19 reflects the reflected light by that reflecting plate 23 while having the reflecting plate 23 of the concave surface configuration reflected towards a lower part side so that the light which emits light from the halogen lamp 22 which emits light with the power supplied from a power circuit 21, and this halogen lamp 22 may be made to condense, and is located in the part for measurement is formed. And the shutter device 25 which the light reflected with the reflecting mirror 24 can switch to

the condition that the part 1 for internal quality measurement irradiates, and the condition of intercepting light, freely is established.

[0044] In said light sensing portion 20 The condenser lens 26 which condenses the light which penetrated the measured object M, the reflecting mirror 27 which reflects light upward, the color filter 28 which passes only the light of a wavelength field for measurement which is mentioned later, and the shutter device 29 which can be freely switched to the open condition of passing light, and the closed state which intercepts light, if incidence of the light which passed the shutter device 29 of an open condition is carried out -- the light -- a spectrum -- carrying out -- said spectrum -- it has the spectroscopy 30 which measures spectrum data, and is constituted.

[0045] detecting the optical reinforcement for every wavelength in which a spectrum was carried out by the reflecting mirror 32 which reflects the light which carried out incidence from ON **** 31, the concave grating 33 which carries out the spectrum of the reflected light to the light of two or more wavelength, and the concave grating 33, as said spectroscopy 30 is shown in drawing 9 -- a spectrum -- the photo sensor 34 which measures spectrum data has the composition arranged in the black box 35 which consists of a protection-from-light nature ingredient which shades the light from the outside.

[0046] Said photo sensor 34 consists of 1024-bit MOS mold line sensors which change and output the transmitted light by which the part light reflex was carried out by the concave grating 33 to the signal for every wavelength while receiving light for every wavelength to coincidence. Although a detailed explanation is not carried out, this line sensor carries out the interior of the drive circuit for making the capacitor which accumulates the charge obtained in optoelectric transducers, such as a photodiode, and the optoelectric transducer of those for every unit pixel, and its stored charge output outside etc., and is constituted. In addition, an above-mentioned line sensor can make the charge storage time by the capacitor change through a drive circuit from the exterior, and it is constituted so that the light of the wavelength of the range which is 700nm - 1100nm can be detected.

[0047] Said floodlighting section 19 and light sensing portion 20 can be prepared in the condition of being supported in one with the frame 36 prepared so that the upper part side of the part 1 for internal quality measurement through which the measured object M passes might be bypassed, and this frame 36 can carry out now modification accommodation of the location of the vertical direction of that whole to the conveyance conveyor 2 by the vertical regulatory mechanism 37. Although a detailed explanation is not carried out about said vertical regulatory mechanism 37, it is installed in the state of location immobilization to a fixed part F, and it is constituted so that it may be made to move up and down by screw delivery device 37b driven in electric motor 37a.

[0048] You make it located in the upper part side of the passage part of the measured object M in said conveyance conveyor 2, and the reference filter 38 which is an example of a criteria object is formed in the condition that location immobilization is carried out, by the fixed part F. This reference filter 38 consists of light filters which have a predetermined absorbance property, and, specifically, is constituted using opal glass.

[0049] And as by carrying out centering control of the whole frame 20 in the vertical direction shows to (b) of drawing 10 As it is indicated in (b) of drawing 10 as the usual measurement condition received by the light sensing portion 20 after the light from the floodlighting section 19 penetrates the measured object M laid in the conveyance conveyor 2 After the light from the floodlighting section 19 penetrates the reference filter 38, it is constituted so that it can switch to the reference measurement condition received by the light sensing portion 20.

[0050] As shown in drawing 2 , said internal quality analysis processing section 7 is constituted using the microcomputer, and has composition which controls actuation of each part, such as modification accommodation of the supply voltage supplied to a halogen lamp 22, and a switching action of the shutter device of floodlighting section 19 and light sensing portion 20 each, actuation of the vertical regulatory mechanism 37. Moreover, the internal quality analysis processing section 7 is constituted so that data processing which analyzes the internal quality of the measured object M may be performed based on the measurement result obtained with the spectroscopy 30.

[0051] The control action by said internal quality analysis processing section 7 is explained. Said

internal quality analysis processing section 7 is usually constituted free [a switch in data measurement mode] with criteria data measurement mode. the spectrum which said criteria data measurement mode was performed in advance of the usual measurement to the measured object M, and replaced the light from the floodlighting section 19 with the measured object M, irradiated said reference filter 38, carried out the spectrum of the transmitted light from the reference filter 38 by the light sensing portion 20, received the light which carried out the spectrum, and was obtained -- spectrum data -- criteria -- a spectrum -- it is constituted so that it may ask as spectrum data. moreover, said measured object M by which data measurement mode is usually conveyed by conveyance conveyor 2 -- receiving -- the floodlighting section 19 to light -- irradiating -- measurement -- a spectrum -- spectrum data -- obtaining -- this measurement -- a spectrum -- spectrum data and criteria -- a spectrum -- based on spectrum data, it is constituted so that the internal quality of the measured object M may be analyzed.

[0052] About each above-mentioned mode, explanation is added hereafter. First, in criteria data measurement mode, it is in the condition of stopping conveyance of the measured object M by the conveyance conveyor 2, and the vertical regulatory mechanism 37 is operated and said frame 36 is switched to said reference measurement condition. and the spectrum which switched each shutter device to the open condition, replaced the light from the floodlighting section 19 with the measured object M, irradiated said reference filter 38, carried out the spectrum of the transmitted light from the reference filter 38 by the light sensing portion 20, received the light which carried out the spectrum, and was obtained -- spectrum data -- criteria -- a spectrum -- it measures as spectrum data.

[0053] And in criteria data measurement mode, the detection value (dark current data) of the photo sensor 34 in the non-light condition that the light to a light sensing portion 2 was intercepted is also measured. That is, he switches the shutter device of said light sensing portion 20 to a closed state, and is trying to calculate the detection value in every unit pixel of the photo sensor 34 at that time as dark current data.

[0054] next -- whenever it conveys the object M measured [this / operate / in / usually / data measurement mode / the vertical regulatory mechanism 37, usually switch a frame 36 to a measurement condition, and according to the conveyance conveyor 2] and each ***** M passes through the part for measurement -- each measurement -- a spectrum -- spectrum data are measured. In addition, the amount of floodlighting in the floodlighting means 19 and charge accumulation-of-electricity time amount of a line sensor are made into the set-up constant value.

[0055] And based on the positional information of the measured object M in the conveyance direction in the conveyance conveyor 2 in case the visual-inspection processing section 6 inspects the appearance of the measured object M, the internal quality analysis processing section 7 manages the positional information of the measured object M to the part 1 for internal quality measurement, and it is constituted so that the floodlighting section 19 and a light sensing portion 20 may be controlled.

[0056] If explanation is added, since the appearance detecting element 5 will detect the appearance information on the measured object M that it is located in the part 4 for visual-inspection measurement While inspecting the appearance of the measured object M based on the detection information on the appearance detecting element 5, the visual-inspection processing section 6 can acquire the positional information of the measured object M in the conveyance direction based on the detection information on the appearance detecting element 5, when it inspects the appearance of the measured object M. And the internal quality analysis processing section 7 manages the positional information of the measured object to the part 1 for internal quality measurement based on the positional information of the measured object M in the conveyance direction acquired when inspecting the appearance of the measured object M, and it is constituted so that a light projecting/receiving part 3 may operate to the timing to which the measured object M conveyed by conveyance conveyor 2 is located in the part 1 for internal quality measurement.

[0057] Thus, by operating a light projecting/receiving part 3 to the timing located in the part 1 for internal measurement, the internal quality analysis processing section 7 is constituted so that the internal quality of the measured object M may be analyzed by the light which received light with the light projecting/receiving part 3. Therefore, even if it does not establish a positional information detection

means to detect the positional information of the measured object M in the conveyance direction etc. While the internal quality analysis processing section 7 can analyze the internal quality of the measured object M and analyzes the internal quality of the measured object M It became possible to aim at reduction of cost and to attain easy-ization of installation and a maintenance, making it possible to inspect the appearance of the measured object M.

[0058] When inspecting the appearance of the measured object M, specifically, the visual-inspection processing section 6 is constituted so that the positional information of the measured object M of the timing to which the measured object M passed through the part for visual-inspection measurement, i.e., the conveyance direction, may be acquired from the photography timing of the measured object M by color CCD camera 9 etc. Moreover, the internal quality analysis processing section 7 is constituted so that it may ask for the timing to which the conveyance direction mid gear of each ***** M conveyed in the part 1 for internal quality measurement passes through the part 1 for internal quality measurement based on the positional information of the measured object M in the conveyance direction acquired in the visual-inspection processing section 6, and the bearer rate of the conveyance conveyor 2 detected by the rotary encoder 39.

[0059] Incidentally about the bearer rate of the conveyance conveyor 2 Since it is set up so that one measured object M may pass through the range of an image pick-up field by the setup time (for example, for about 1 second) The conveyance direction mid gear of each ***** M conveyed as the set-up bearer rate in the part 1 for internal quality measurement, without forming a rotary encoder 39 is possible also for asking for the timing which passes through the part 1 for internal quality measurement.

[0060] The conveyance direction mid gear of the measured object M the internal quality analysis processing section 7 rather than the timing which passes through the part for measurement and from before the setup time Time amount until the conveyance direction mid gear of the measured object M carries out setup-time progress from the timing which passes through the part for measurement is set up with the charge accumulation-of-electricity time amount of a line sensor, whenever each ***** M passes through the part for measurement -- the light income of each photo sensor 18 -- measuring -- measurement -- a spectrum -- he is trying to measure spectrum data In addition, before measuring the light income of a photo sensor 18, empty reading actuation which carries out empty reading of the detection value of a photo sensor 18 is performed, and you may make it extract the charge which the capacitor has already stored electricity.

[0061] Said internal quality analysis processing section 7 is constituted so that data processing which analyzes the internal quality of the measured object M using the spectral-analysis technique based on the various data obtained by doing in this way may be performed. namely, measurement -- a spectrum -- spectrum data and criteria -- a spectrum -- while acquiring the quadratic differential value in the wavelength field of the absorbance spectrum for every wavelength by which the spectrum was carried out, and an absorbance spectrum based on spectrum data and dark current data, it is constituted so that analysis data processing which computes the amount of components corresponding to the sugar content contained in the measured object M by the quadratic differential value and the amount of components corresponding to acidity may be performed. an absorbance d -- criteria -- a spectrum -- spectrum data -- Rd and measurement -- a spectrum -- if spectrum data are set to Sd and dark current data are set to Da --

[0062]

[Equation 4]

$$d=\log\{(Rd-Da)/(Sd-Da)\}$$

[0063] Coming out and defining, the internal quality analysis processing section 7 computes the amount of components contained in the measured object M based on the multiple regression analysis by following several 5.

[0064]

[Equation 5]

$$Y=K0+K1, A(\lambda 1) +K2, \text{ and } A(\lambda 2)$$

[0065] However, Y ; The amounts K0, K1, and K2 of components ; A coefficient A (λ 1), A (λ 2) ; quadratic differential value of the absorbance spectrum in the specific wavelength λ

[0066] In addition, for every component which computes the amount of components, the specific amount formula of components, the specific multipliers K_0 , K_1 , and K_2 , wavelength λ_1 and λ_2 , etc. are beforehand set up by the internal quality analysis processing section 7, it memorizes, and it has at it the composition of computing the amount of components of each component using the specific amount formula of components for every component of this.

[0067] The [2nd operation gestalt] In the above-mentioned 1st operation gestalt, this 2nd operation gestalt shows another operation gestalt about the control action at the time of the internal quality analysis processing section 7 analyzing the internal quality of the measured object M, and explains the control action of that internal quality analysis processing section 7. In addition, with this 2nd operation gestalt, since it is the same as that of the above-mentioned 1st operation gestalt about the configuration of others other than the control action of the above-mentioned internal quality analysis processing section 7, that explanation is omitted by the above-mentioned 1st operation gestalt and a same sign being shown etc.

[0068] Said internal quality analysis processing section 7 is constituted so that the measurement conditions when analyzing the internal quality of the measured object M may be adjusted based on the detection information on the appearance detecting element 5. That is, the internal quality analysis processing section 7 is constituted so that the amount of light emitting/receiving by the light projecting/receiving part 3 when analyzing the internal quality of the measured object M may be adjusted based on the detection information on the appearance detecting element 5.

[0069] If the appearance of the measured objects M, such as a configuration of the measured object M and magnitude, generally changes that the quantity of light of the transmitted light of the measured object M will decrease, so that the magnitude of the measured object M becomes large for example, if explanation is added etc. The quantity of light of the transmitted light of the measured object M will change, and the transmitted light of the measured object M of a setting proper amount cannot be received by the light sensing portion 20, but there is a possibility that the internal quality of the measured object M may be immeasurable with a sufficient precision. Then, the amount of light emitting/receiving by the light projecting/receiving part 3 in case the internal quality analysis processing section 7 analyzes the internal quality of the measured object M based on appearance information acquired from the detection information on the appearance detecting element 5, such as a configuration of the measured object M and magnitude, is adjusted. According to the appearance information on the measured object M, it is constituted so that the light of a setting proper amount may be received with a light projecting/receiving part 3, and the amount of light emitting/receiving of a light projecting/receiving part 3 may be adjusted.

[0070] That is, in order that precision may improve internal quality of the measured object M, even if it does not establish a means of detection detect the appearance information on the measured object M, using the appearance information on the measured object M obtained when inspecting the appearance of the measured object M, the amount of light emitting/receiving of a light projecting/receiving part 3 is adjusted, and it is constituted so that the transmitted light of the measured object M of a setting proper amount may be received with a light projecting/receiving part 3. Since the visual-inspection processing section 6 will inspect the appearance of the measured object M based on the detection information on the appearance detecting element 5, specifically In that case, appearance information, such as a configuration of the measured object M and magnitude, can be acquired. The internal quality analysis processing section 7 Based on the appearance information on the obtained measured object M, it is constituted so that the magnitude of the measured object M is large, and floodlighting reinforcement by the floodlighting section 19 may be enlarged, and modification accommodation of the supply voltage supplied to a halogen lamp 6 may be carried out.

[0071] Moreover, like the above-mentioned 1st operation gestalt, based on the positional information of the measured object M in the conveyance direction in the conveyance conveyor 2 in case the visual-inspection processing section 6 inspects the appearance of the measured object M, the internal quality analysis processing section 7 manages the positional information of the measured object M to the part 1 for internal quality measurement, and it is constituted so that the floodlighting section 19 and a light

sensing portion 20 may be controlled.

[0072] Incidentally with this 2nd operation gestalt, the optical passage sensor which detects passage of the measured object M is formed in the upstream rather than the part for internal quality measurement in the conveyance direction of the conveyance conveyor 2. The internal quality analysis processing section 7 The detection information on said passage sensor, It is also possible to constitute and carry out so that it may ask for the timing to which the conveyance direction mid gear of each ***** M conveyed in the part 1 for internal quality measurement passes through the part 1 for internal quality measurement based on the detection information on a rotary encoder 39.

[0073] The [3rd operation gestalt] In the above-mentioned 2nd operation gestalt, this 3rd operation gestalt shows another operation gestalt about the control action at the time of the internal quality analysis processing section 7 analyzing the internal quality of the measured object M, and explains the control action of that internal quality analysis processing section 7. In addition, with this 3rd operation gestalt, since it is the same as that of the above-mentioned 2nd operation gestalt about the configuration of others other than the control action of the above-mentioned internal quality analysis processing section 7, that explanation is omitted by the above-mentioned 2nd operation gestalt and a same sign being shown etc.

[0074] Said internal quality analysis processing section 7 is constituted so that the measurement conditions when analyzing the internal quality of the measured object M may be adjusted based on the detection information on the appearance detecting element 5. That is, based on the magnitude information on the measured object M in the detection information on the appearance detecting element 5, the internal quality analysis processing section 7 is constituted so that the relative-position relation between the part 1 for internal quality measurement and a light projecting/receiving part 3 may be adjusted.

[0075] When explanation was added, for example the relative-position relation between the part 1 for internal quality measurement and a light projecting/receiving part 3 is fixed to the relative-position relation suitable for what has the large magnitude of the measured object M If the magnitude of the measured object M becomes small, the light which turns around the measured object M among the light which irradiated the measured object 1 will arise. The light around which it turned will be received with a light projecting/receiving part 3, an S/N (signal pair noise) ratio becomes small, and there is a possibility that the internal quality of the measured object M may be immeasurable with a sufficient precision. Then, the internal quality analysis processing section 7 adjusts the relative-position relation between the part 1 for internal quality measurement, and a light projecting/receiving part 3 based on the magnitude information on the measured object M in the detection information on the appearance detecting element 5, and it is constituted so that the light to which the light projecting/receiving part 3 turned around the measured object M may not be received according to the magnitude of the measured object M.

[0076] Namely, in order that precision may improve internal quality of the measured object M, even if it does not establish a means of dedication to detect the magnitude information on the measured object M, the magnitude information on the measured object M obtained when inspecting the appearance of the measured object M is used. The relative-position relation between the part 1 for internal quality measurement and a light projecting/receiving part 3 is adjusted, and it is constituted so that the light to which the light projecting/receiving part 3 turned around the measured object M may not be received.

[0077] Since the visual-inspection processing section 6 will inspect the appearance of the measured object M based on the detection information on the appearance detecting element 5, specifically In that case, the magnitude information on the measured object M can be acquired. The internal quality analysis processing section 7 Based on the magnitude information on the obtained measured object M, as shown in drawing 11 It adjusts by the vertical regulatory mechanism 37 so that a light projecting/receiving part 3 may be arranged at an upper part side, and it is constituted so that the measured object M may be irradiated in the floodlighting section 19 focusing on the central part of the measured object M, so that the magnitude of the measured object M is large.

[0078] Incidentally it sets in this 3rd operation gestalt. The internal quality analysis processing section 7

While adjusting the relative-position relation between the part 1 for internal quality measurement, and a light projecting/receiving part 3 based on the magnitude information on the measured object M in the detection information on the appearance detecting element 5 By adjusting the amount of light emitting/receiving by the light projecting/receiving part 3 when analyzing the internal quality of the measured object M like the above-mentioned 2nd operation form attitude based on the detection information on the appearance detecting element 5 It is also possible to constitute so that the measurement conditions when analyzing the internal quality of the measured object M may be adjusted based on the detection information on the appearance detecting element 5.

[0079] Moreover, like the above-mentioned 1st operation gestalt, based on the positional information of the measured object M in the conveyance direction in the conveyance conveyor 2 in case the visual-inspection processing section 6 inspects the appearance of the measured object M, the internal quality analysis processing section 7 manages the positional information of the measured object M to the part 1 for internal quality measurement, and it is constituted so that the floodlighting section 19 and a light sensing portion 20 may be controlled.

[0080] Incidentally with this 3rd operation gestalt, the optical passage sensor which detects passage of the measured object M is formed in the upstream rather than the part for internal quality measurement in the conveyance direction of the conveyance conveyor 2. The internal quality analysis processing section 7 The detection information on said passage sensor, It is also possible to constitute and carry out so that it may ask for the timing to which the conveyance direction mid gear of each ***** M conveyed in the part 1 for internal quality measurement passes through the part 1 for internal quality measurement based on the detection information on a rotary encoder 39.

[0081] [Another operation gestalt]

(1) What is necessary is to be able to be adapted in various kinds of image pick-up means, such as what obtains the camera and the monochrome image of the formula between image pick-ups, and just to be able to detect the appearance information on the measured object M as an appearance detecting element 5, although the above-mentioned operation gestalt showed the example which used color CCD camera 9 as an appearance detecting element 5.

[0082] (2) Although the above-mentioned operation gestalt showed the example which constitutes the floodlighting section 19 and a light sensing portion 20 for a light projecting/receiving part 3 in each **, it is also possible to constitute and carry out a light projecting/receiving part 3 with one light projecting/receiving part.

[0083] (3) Although charge accumulation-of-electricity time amount of the line sensor as a photo sensor is made into the set-up constant value with the above-mentioned operation gestalt, you may make it, change the charge accumulation-of-electricity time amount of a line sensor for example, according to measurement conditions, such as a form of the measured object M, and magnitude.

[0084] (4) Although the spectrum of the light received with the light projecting/receiving part 3 was carried out, and it constituted from an above-mentioned operation gestalt based on optical spectrum data that much so that the internal quality of the measured object M might be analyzed It does not restrict to the approach using spectral analysis, and you may make it analyze the internal quality of the measured object M about the approach of analyzing the internal quality of the measured object M, using various kinds of analysis approaches.

[0085] (5) Although the conveyance conveyor 2 was considered as the configuration which drives endless rotation band 2a with electric motor 2b with the above-mentioned operation gestalt, various kinds of conveyance means, such as constituting the conveyance conveyor 2 in a roller conveyor, can be adapted.

[0086] (6) Although the bearer rate of the conveyance conveyor 2 was set up with the above-mentioned 1st operation gestalt so that one measured object M might pass through the range of an image pick-up field by the setup time (for example, for about 1 second), you may constitute possible [modification of the bearer rate of the conveyance conveyor 2], and he is trying to adjust the image pick-up timing by color CCD camera 9 in this case based on the detection information on a rotary encoder 39.

[0087] (7) Although it constituted from an above-mentioned 2nd operation gestalt so that supply voltage

might be adjusted and the floodlighting reinforcement by the floodlighting section 19 might be adjusted based on the appearance information on the measured object M obtained when inspecting the appearance of the measured object M. For example, the diaphragm device equipped with two or more converging sections with which the amounts of diaphragms differ is established by making the amount of floodlighting by the floodlighting section 19 into a constant rate. It is also possible to constitute and carry out so that the light from the floodlighting section 19 may be extracted and the amount of diaphragms by the device may be adjusted based on the appearance information on the measured object M obtained when inspecting the appearance of the measured object M. Moreover, it replaces with a diaphragm device and you may make it establish the extinction device equipped with two or more extinction objects with which the amounts of extinction differ in this case.

[0088] (8) Although it constituted from an above-mentioned 3rd operation gestalt so that the location of the vertical direction might be adjusted for the floodlighting section 19 and a light sensing portion 20 and the relative-position relation between the part 1 for internal quality measurement and a light projecting/receiving part 3 might be adjusted based on the magnitude information on the measured object M obtained when inspecting the appearance of the measured object M. It is also possible to constitute so that a lateral location may be adjusted for the floodlighting section 19 and a light sensing portion 20 and the relative-position relation between the part 1 for internal quality measurement and a light projecting/receiving part 3 may be adjusted based on the magnitude information on the measured object M.

[0089] (9) With the above-mentioned operation gestalt, although the filter by opal glass was used as a criteria object, the quality of the material is not limited that what is necessary is just what has a predetermined absorbance property besides diffusion plates, such as not only this but an obscured glass. Moreover, you may make it a photo sensor also use other detection means, such as not only an MOS mold line sensor but a CCD mold line sensor.

[0090] (10) the above-mentioned operation gestalt -- the transmitted light from the measured object M -- being based -- a spectrum -- although it constituted so that a spectrum might be measured -- this configuration -- replacing with -- the reflected light from the measured object M -- being based -- a spectrum -- it is also possible to constitute and carry out so that a spectrum may be measured.

[0091] (11) With the above-mentioned operation gestalt, as internal quality of the measured object M, although a sugar content and acidity were illustrated, the other internal quality, such as information not only on this but a flavor, may be measured.

[Translation done.]

* NOTICES *

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Drawing showing the conveyance condition by the conveyance conveyor in evaluation equipment

[Drawing 2] The control-block Fig. of evaluation equipment

[Drawing 3] The side elevation of the conveyance direction in the part for appearance measurement of evaluation equipment

[Drawing 4] The side elevation of the direction which intersects perpendicularly in the conveyance direction in the part for appearance measurement of evaluation equipment

[Drawing 5] The top view in the part for appearance measurement of evaluation equipment

[Drawing 6] The explanatory view of a control means of operation

[Drawing 7] The explanatory view of a control means of operation

[Drawing 8] the part for internal quality measurement of evaluation equipment -- the side elevation of the conveyance direction to kick

[Drawing 9] Drawing showing the important section in the part for internal quality measurement of evaluation equipment

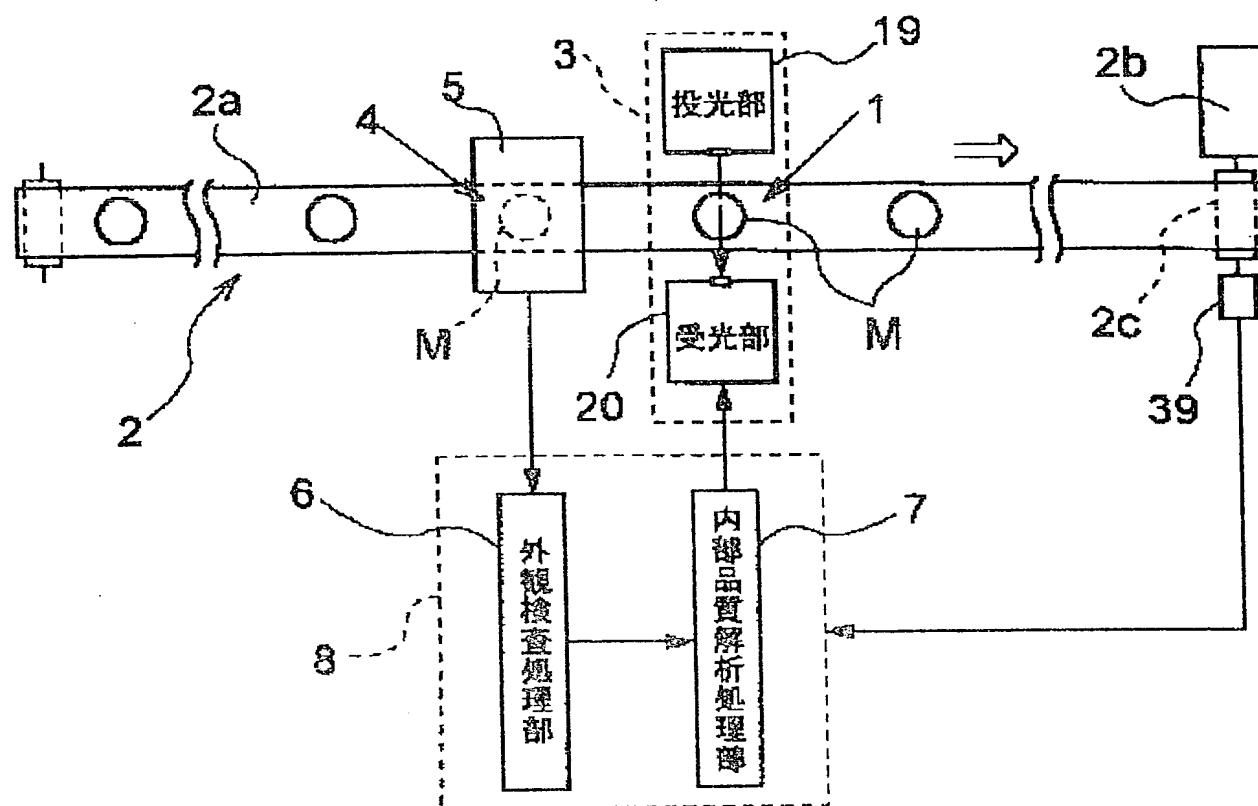
[Drawing 10] Drawing showing the vertical repositioning condition in the part for internal quality measurement of evaluation equipment

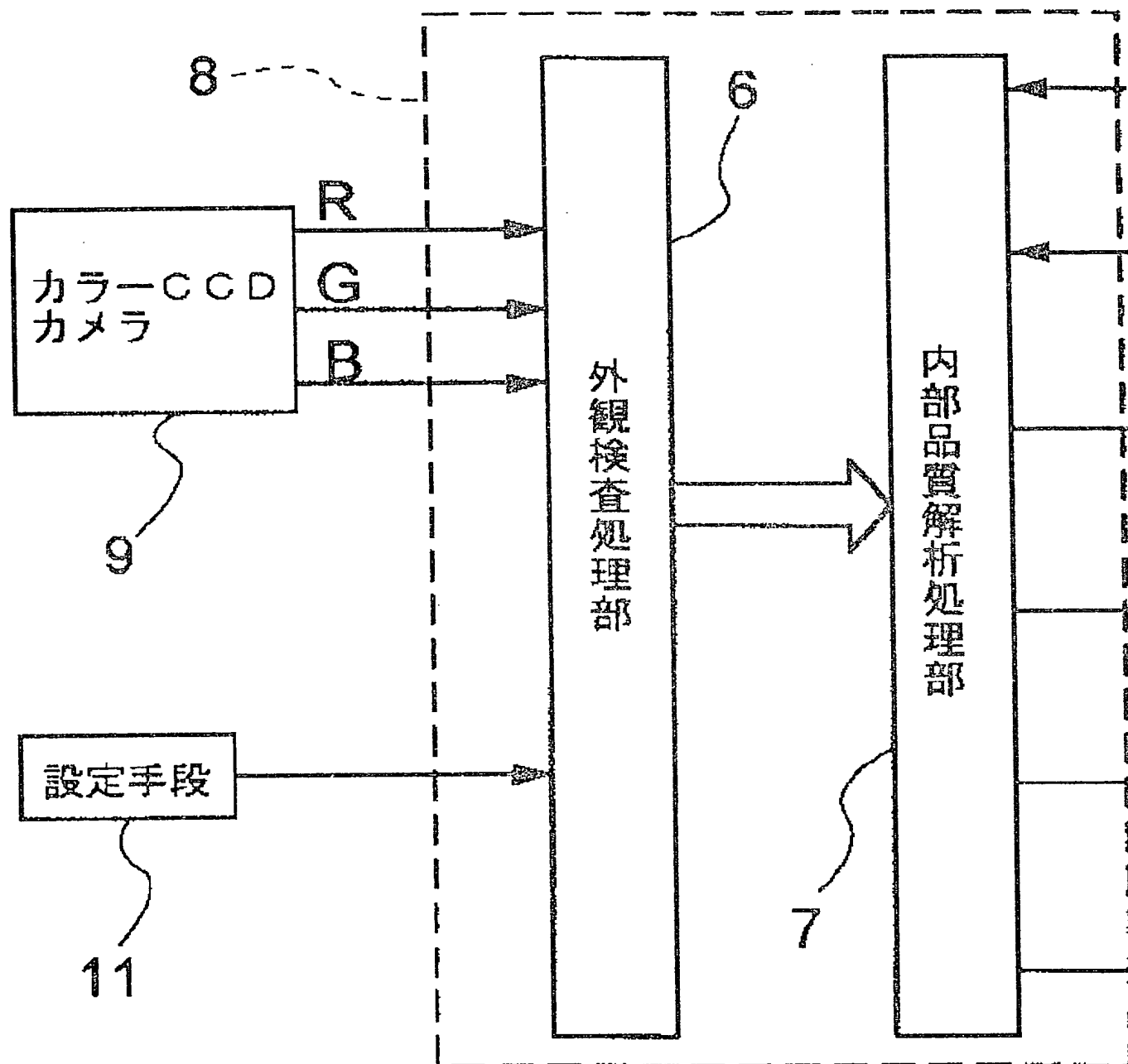
[Drawing 11] Drawing showing the vertical repositioning condition in the part for internal quality measurement of the evaluation equipment of the 3rd operation gestalt

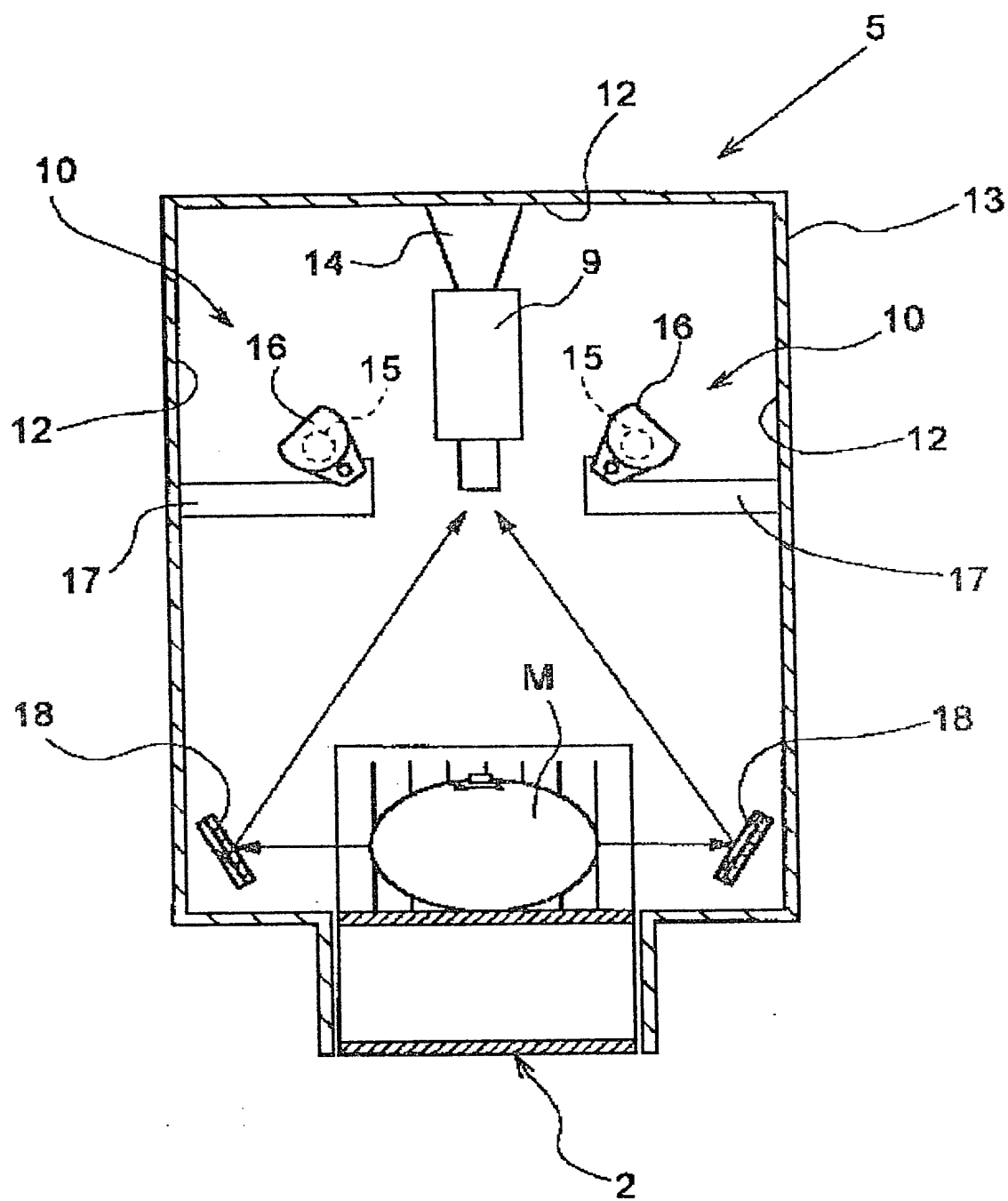
[Description of Notations]

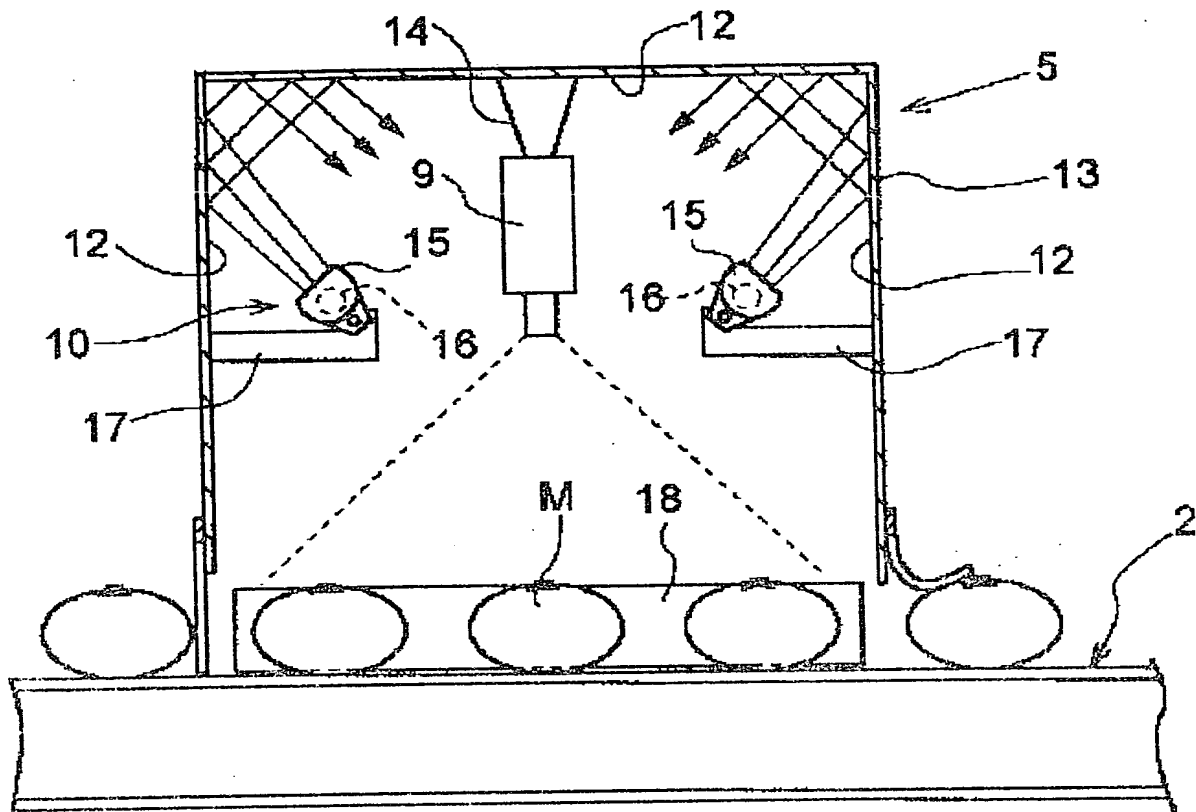
- 1 Part for Internal Quality Measurement
- 2 Conveyance Means
- 3 Light Emitting/receiving Means
- 4 Part for Visual-Inspection Measurement
- 5 Appearance Detection Means
- 8 Control Means

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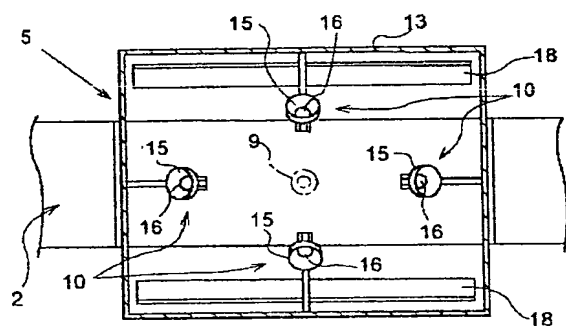




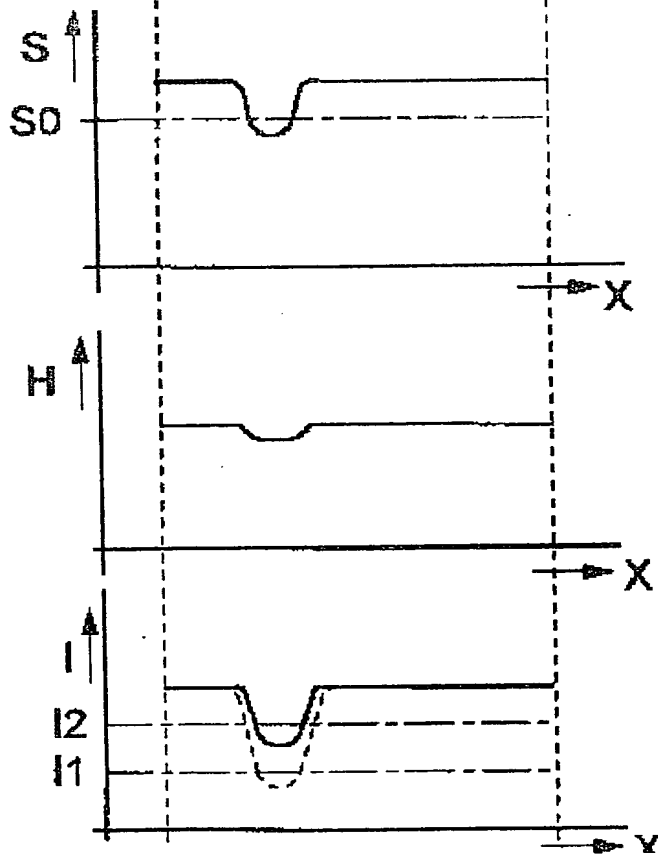
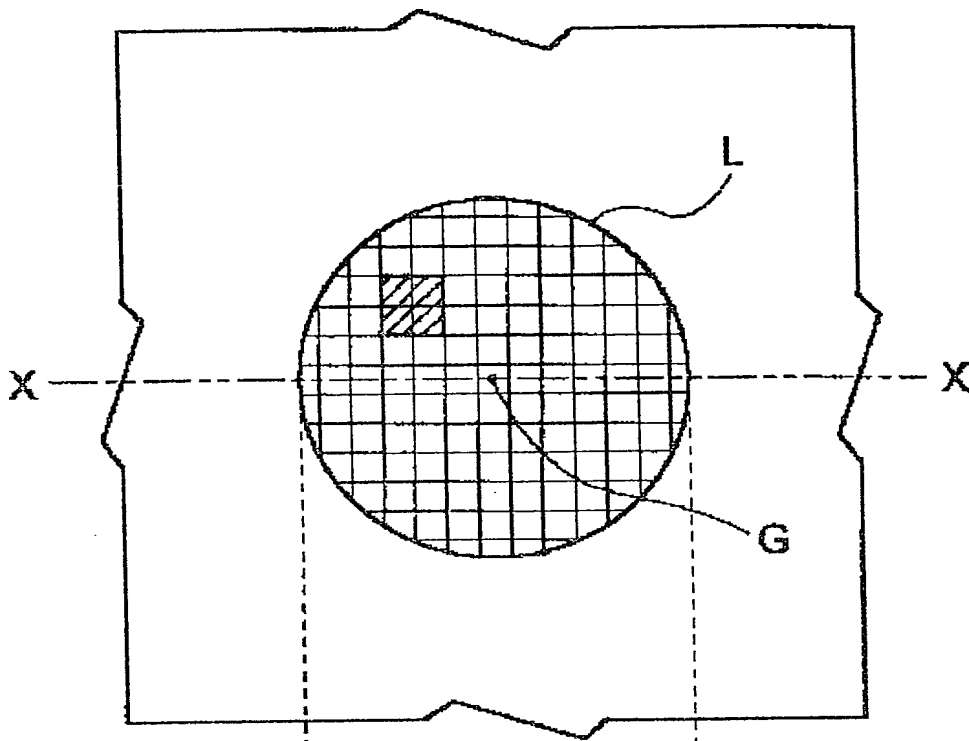




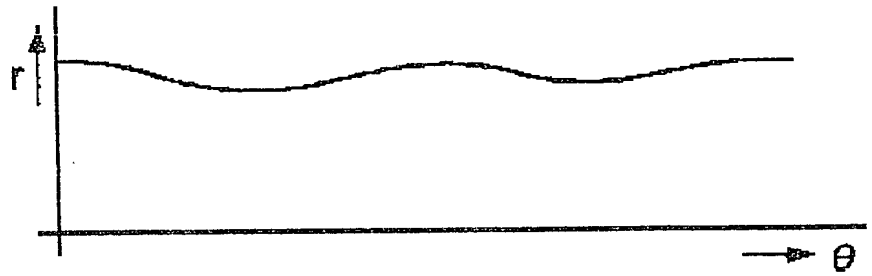
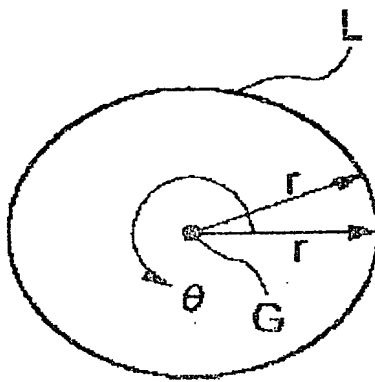
Drawing selection **drawing 5**



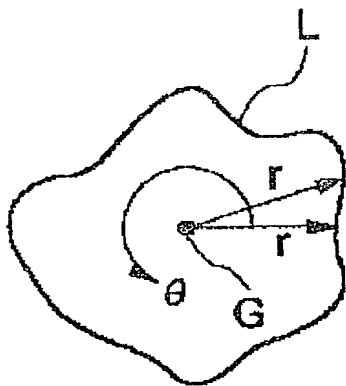
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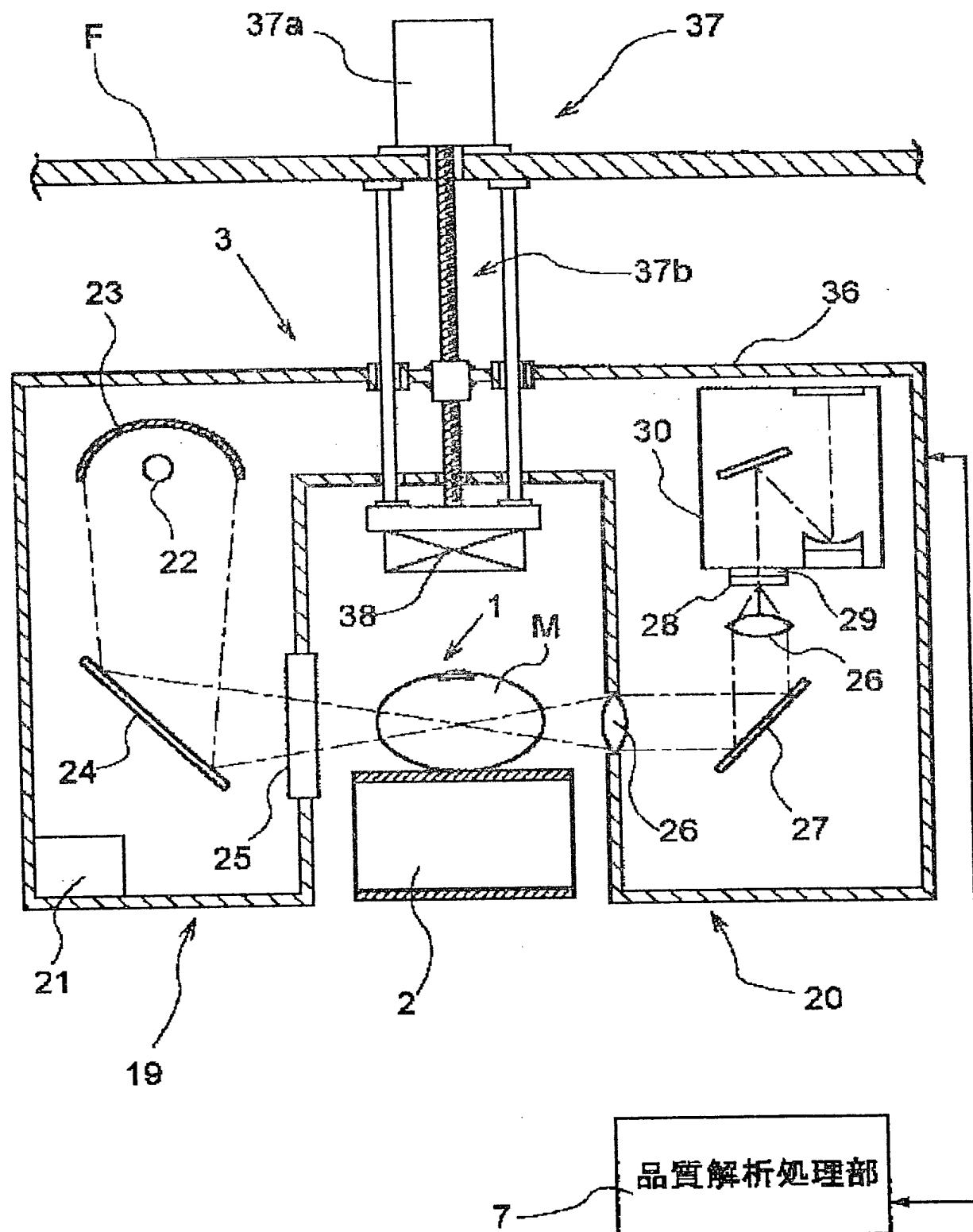


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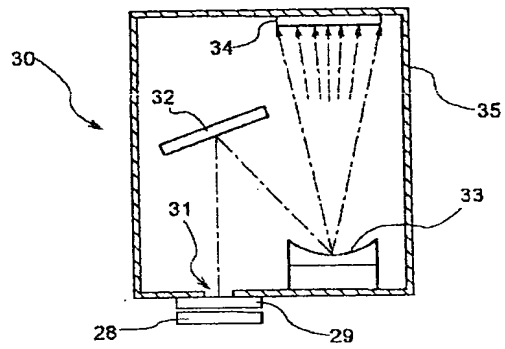


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Drawing selection drawing 9



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